WATERSHED PLAN and ENVIRONMENTAL IMPACT STATEMENT

HALL-FLAT CREEK WATERSHED

Dubois County, Indiana

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

USDA-SCS-LINCOLN, NEBR. 1976

WATERSHED PLAN AND

ENVIRONMENTAL IMPACT STATEMENT

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Dubois County, Indiana

Prepared under the Authority of the Watershed Protection and Flood Prevention Act, Public Law 83-566, as amended (16 USC 1001-1008) and in accordance with Section 102(2)(C) of the National Environmental Policy Act of 1969, Public Law 91-190, as amended (42 USC 4321 et seq).

Prepared by: Dubois County Soil and Water Conservation District
Hall-Flat Conservancy District
Indiana Department of Natural Resources
U.S. Department of Agriculture, Soil Conservation Service
U.S. Department of Agriculture, Forest Service

April 1976

PREFACE

Enclosed are two documents--the Watershed Plan and Environmental Impact Statement for Hall-Flat Creek Watershed, Indiana.

The Watershed Plan has been developed by the local sponsors with the assistance of the U.S. Department of Agriculture and is the basis for the authorization of federal assistance to implement the proposed project in accordance with the Watershed Protection and Flood Prevention Act, Public Law 83-566, as amended (16 USC 1001-1008).

The Environmental Impact Statement has been prepared by the U.S. Department of Agriculture in compliance with Section 102(2)(C) of the National Environmental Policy Act of 1969, Public Law 91-190, as amended (42 USC 4321 et seq).

The Environmental Impact Statement contains the detailed information on project area, planned project, problems, impacts, alternatives, etc.

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AGREEMENT

between the following local organizations

Dubois County Soil and Water Conservation District
Hall-Flat Creek Conservancy District
(Referred to herein as the Sponsoring Local Organizations)

State of Indiana
and the
Soil Conservation Service
United States Department of Agriculture
(Referred to herein as the Service)

Whereas, application has heretofore been made to the Secretary of Agriculture by the Sponsoring Local Organizations for assistance in preparing a plan for works of improvement for the Hall-Flat Creek Watershed, State of Indiana, under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress, 68 Stat. 666), as amended, and

Whereas, the responsibility for administration of the Watershed Protection and Flood Prevention Act, as amended, has been assigned by the Secretary of Agriculture to the Service, and

Whereas, there has been developed through the cooperative efforts of the Sponsoring Local Organizations and the Service a mutually satisfactory plan for works of improvement for the Hall-Flat Creek Watershed, State of Indiana, hereinafter referred to as the Watershed Plan, which is annexed to and made a part of this agreement.

Now, therefore, in view of the foregoing considerations, the Sponsoring Local Organizations and the Secretary of Agriculture, through the Service, hereby agree on the Watershed Plan, and further agree that the works of improvement, as set forth in said Plan can be installed in seven years.

It is mutually agreed that in installing and operating and maintaining the works of improvement substantially in accordance with the terms, conditions, and stipulations provided for in the Watershed Plan:

1. The Sponsoring Local Organization will acquire, with other than PL-566 funds, such land rights as will be needed in connection with the works of improvement (Estimated cost $295,940). 1/

2. The Sponsoring Local Organization assures that comparable replacement dwellings will be available for individuals and persons

1/ In addition to this cost, $3,000 are included in construction costs to accomodate rerouting county road along top of flood retarding structure No. 32.

displaced from dwellings, and will provide relocation advisory services and relocation assistance, make the relocation payments to displaced persons, and otherwise comply with the real property acquisition policies contained in the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646, 84 Stat. 1894) effective as of January 2, 1971, and the Regulations issued by the Secretary of Agriculture pursuant thereto. The costs of relocation payments will be shared by the Sponsoring Local Organization and the Service as follows:

	Hall-Flat Creek Cons. District (Percent)	Service (Percent)	Estimated Relocation Payment Costs (Dollars)
Relocation Payments	25.46	74.54	$2,500

3. The Sponsoring Local Organizations will acquire or provide assurance that landowners or water users have acquired such water rights pursuant to State law as may be needed in the installation and operation of the works of improvement.

4. The percentages of construction costs of structural measures to be paid by the Sponsoring Local Organizations and by the Service are as follows:

Works of Improvement	Hall-Flat Creek Cons. District (Percent)	Service (Percent)	Estimated Cost (Dollars)
Floodwater Retarding Structure 32	6.12	93.88	$48,990 1/
All other Structural Measures	0	100	$1,539,070

5. The percentages of the engineering costs to be borne by the Sponsoring Local Organizations and the Service are as follows:

Works of Improvement	Hall-Flat Creek Cons. District (Percent)	Service (Percent)	Estimated Cost (Dollars)
All Structural Measures	0	100	$176,805

6. The Sponsoring Local Organizations and the Service will each bear the costs of project administration which they incur, estimated to be $31,900 and $253,705 respectively.

1/ Includes $3,000 for modification to accomodate rerouting county road along top of dam.

7. The Dubois County Soil and Water Conservation District will obtain agreements from owners of not less than 50 percent of the land above each floodwater retarding structure that they will carry out conservation farm plans on their land.

8. The Dubois County Soil and Water Conservation District will provide assistance to landowners and operators to assure the installation of the land treatment measures shown in the watershed plan.

9. The Sponsoring Local Organizations will encourage landowners and operators to operate and maintain the land treatment measures for the protection and improvement of the watershed.

10. The Sponsoring Local Organizations will be responsible for the operation and maintenance of all structural works of improvement by actually performing the work or arranging for such work in accordance with agreements to be entered into prior to issuing invitations to bid for construction.

11. The costs shown in this agreement represent preliminary estimates. In finally determining the cost to be borne by the parties hereto, the actual cost incurred in the installation of works of improvement will be used.

12. This agreement is not a fund obligating document. Financial and other assistance to be furnished by the Service in carrying out the watershed plan is contingent on the availability of appropriations for this purpose.

13. A separate agreement will be entered into between the Service and the Sponsoring Local Organizations before either party initiates work involving funds of the other party. Such agreement will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific work of improvement.

14. The watershed plan may be amended or revised, and this agreement may be modified or terminated only by mutual agreement of the parties hereto except for cause. The Service may terminate financial and other assistance in whole, or in part, at any time whenever it is determined that the Sponsoring Local Organization has failed to comply with the conditions of this agreement. The Service shall promptly notify the Sponsoring Local Organization in writing of the determination and the reasons for the termination, together with the effective date. Payments made to the Sponsoring Local Organization or recoveries by the Service under projects terminated for cause shall be in accord with the legal rights and liabilities of the parties. An amendment to incorporate changes affecting one specific structural measure may be made by mutual agreement between the Service and the sponsor(s) having specific

responsibilites for the particular structural measure involved.

15. No member of or delegate to Congress, or resident commissioner, shall be admitted to any share or part of this agreement, or to any benefit that may arise therefrom; but this provision shall not be construed to extend to this agreement if made with a corporation for its general benefit.

16. The program conducted will be in compliance with all requirements respecting nondiscriminations as contained in the Civil Rights Act of 1964, as amended, and the regulations of the Secretary of Agriculture (7 C.F.R. 15.1-15.12) which provide that no person in the United States shall, on the grounds of race, color, or national origin, be excluded from participation in, be denied the benefit of, or be otherwise subjected to discrimination under any activity receiving federal financial assistance.

17. This agreement will not become effective until the Service has issued a notification of approval and authorizes assistance.

DUBOIS COUNTY SOIL AND WATER CONSERVATION DISTRICT
Local Organization

By /s/Otto J. Bauer

Title Chairman

Box 547, Jasper, IN 47546
Address Zip Code

Date May 21, 1976

The signing of this agreement was authorized by a resolution of the governing body of this Dubois County Soil and Water Conservation District
Local Organization
adopted at a meeting held on May 21, 1976

/s/Walter N. Harris
Secretary, Local Organization

R. R. #2, Jasper, IN 47546
Address Zip Code

Date May 21, 1976

HALL-FLAT CREEK CONSERVANCY DISTRICT
Local Organization

By /s/Raymond Schnaus

Title Chairman

R. R. 1, St. Anthony, IN 47575
Address Zip Code

Date May 18, 1976

The signing of this agreement was authorized by a resolution of the governing body of the Hall-Flat Creek Conservancy District
Local Organization
adopted at a meeting held on May 18, 1976

/s/Leo Betz
Secretary, Local Organization

R. R. 1, St. Anthony, IN 47575
Address Zip Code

Date May 18, 1976

Appropriate and careful consideration has been given to the environmental statement prepared for the project and to the environmental aspects thereof.

Soil Conservation Service
United States Department of Agriculture

Approved by:

/s/Cletus J. Gillman
State Conservationist

May 26, 1976
Date

COMBINED WATERSHED PLAN & EIS
HALL-FLAT CREEK WATERSHED
DUBOIS COUNTY, INDIANA

April 1976

SUMMARY & INTRODUCTION

The Hall-Flat Creek Watershed is located in Dubois County in southwestern Indiana. It consists of an area of 43,107 acres (67.35 sq. mi.). Hall Creek and Flat Creek flow generally in a westerly direction joining to form Straight River approximately two miles from its confluence with the Patoka River.

The watershed is predominately agricultural. The flood plain is intensively cropped and the uplands are more generally in pasture and woods.

Major soil and water needs are watershed protection and flood prevention. The recreation and water supply needs are mostly serviced from outside the watershed area.

Flooding affects approximately 10 percent of the watershed area inflicting damage to crops, pasture, and other agricultural values, as well as roads and bridges.

The project sponsors are the Dubois County Soil and Water Conservation District (SWCD) and the Hall-Flat Creek Conservancy District (District). These sponsors have developed a comprehensive program of accelerated land treatment and structural measures to be installed over a seven year period for the solution of water problems and satisfaction of resource development needs.

Land treatment measures will be installed by individual landowners and operators with technical assistance provided by the Soil Conservation Service (Service) and the IDNR, Division of Forestry, in cooperation with the U. S. Forest Service (USFS). The land treatment measures will reduce soil erosion and reduce sediment concentration in watershed streams and lakes.

The structural measures consist of 22 single purpose floodwater retarding reservoirs, controlling 25.12 square miles of drainage area. More structural data for each structure are listed in Table 3. The planned structural measures were selected after studying many different alternatives. Careful consideration was given to all environmental and economic aspects of the project.

The District will be responsible for the administration of construction contracts and the operation and maintenance of structural measures.

All construction and engineering costs, estimated to be $1,761,865, are to be paid from PL-566 funds. All land rights costs, estimated to be $298,940, are to be paid by other than PL-566 funds. Average annual operation and maintenance costs estimated to be $6,950 are to be paid by other than PL-566 funds. More details on costs are listed in Tables 1, 1A, 2, and 4.

The project will reduce flooding on approximately 4,400 acres of land. It will create 229 acres of sediment pools. These pools will inundate 7.1 miles of ephemeral streams.

Average annual flood damage reduction benefits with and without project are displayed on Table 5. Average annual monetary benefits from project structural measures are estimated to be $252,664 (Table 6). Detailed information on project effects is sited in Part II, Environmental Impact Statement.

PLANNED MEASURES

Land Treatment Measures. The application of soil and water conservation practices will reduce soil loss from erosion, promote the proper use of soil and water resources, and provide lower maintenance costs for the planned structural measures.

The application of land treatment measures will bring an additional 18,025 acres under adequate treatment. This along with the present 19,455 previously treated acres will give a total of 37,480 acres or 87 percent of the watershed adequately treated. The additional conservation practices and measures will be achieved on 5,500 acres of cropland, 5,800 acres of forest land, and 1,375 acres of other land. Adequate land treatment will be achieved on the 18,025 acres or 42 percent of the total watershed during the 7 year project installation period. The remaining area of the watershed will receive partial land treatment or management practices.

Conservation practices to be applied on cropland include contour farming, grassed waterway or outlet, minimum tillage, crop residue management, grade stabilization structure, subsurface drain, and drainage main or lateral. A combination of two or more practices is often needed to achieve adequate treatment of land. Land treatment practices such as waterways, diversions, pasture planting and management, tree planting, critical area planting and rotation of grazing will benefit wildlife. Forest land treatment and protection will not only enhance soil protection, but will also benefit the forest-based economy of the surrounding area. The Soil Conservation Service Technical Guide will be used in planning adequate cropland treatment alternatives.

Pasture land treatment measures to be installed include pasture and hayland planting, and pasture and hayland management.

Land treatment needs and measures have been developed for private forest lands by the IDNR, Division of Forestry in cooperation with the U.S. Forest Service and include the following measures:

Forest Land Management Plans provide professional recommendations for the proper installation and maintenance of forestry measures on private forest land.

Tree Planting to adjust planned land use with capability and reduce runoff and erosion by developing a protective cover and absorbent forest floor of litter and humus.

Hydrologic Stand Improvement Measures to improve the hydrologic condition of private forest stands by manipulation of stand composition to create favorable conditions for the maximum production and protection of litter, humus, and forest cover. They include thinnings, weedings, improvement, salvage, intermediate harvest and harvest cuttings, supplemental plantings, and protection from overgrazing by domestic livestock.

During development of resource conservation plans, landowners will be encouraged to plan and apply forest management practices that are important in developing and maintaining favorable wildlife habitat conditions.

Structures. Structural measures planned are 22 single purpose floodwater retarding reservoirs. Sediment pools range in size from 3.7 acres to 24.1 acres, an average of 10.4 acres. Floodwater pools range in size from 10.1 acres to 65.8 acres, an average of 25.1 acres. An average 61 acre-feet of sediment will accumulate in the sediment pools of each structure over the 100 year life of the project. An average of 209 acre-feet of floodwater will be temporarily stored to the crest of the emergency spillway of each structure.

The dams, ranging in height from 18 feet to 46 feet, will be constructed of earth fill, and will have vegetated earth emergency spillways.

Permanent easements required to construct the 22 reservoirs will involve 619 acres, of which 284 acres are cropland, 133 acres are pastureland, and 202 acres are forest land.

The reservoirs will control the runoff from 25.12 square miles, approximately 37 percent of the watershed.

Table 3 and the Planned Project Subsection in Part II contain more information regarding the single purpose floodwater retarding reservoirs.

INSTALLATION COSTS-MONETARY

Land Treatment Measures. The cost of installing the land treatment measures is summarized in Table 1. Estimated total cost for technical assistance is $177,056 of which $23,700 will be funds from the ongoing program and $153,356 from PL-566 funds. These funds will insure the needed acceleration of the total land treatment program. Landowners and operators will spend, with assistance from going programs, an estimated $386,161 for measures installed on their lands.

A project schedule of PL-566 and other obligations for the installation of land treatment measures is as follows:

Year	Forest land 1/ PL-566	Forest land 1/ Other	All Other land 2/ PL-566	All Other land 2/ Other
		(Dollars)		
1	3,643	5,300	18,265	74,066
2	3,643	5,300	18,265	81,035
3	3,643	5,300	18,265	80,808
4	3,643	5,300	18,265	77,285
5	3,643	5,300	18,265	59,457
6	3,643	5,300	18,265	2,285
7	3,642	5,300	18,266	2,285
TOTAL	25,500	37,100	127,856	372,761

Structural Measures. Installation costs for structural measures to be borne by PL-566 and other funds are shown by cost account category in Table 2 and in summary form in Table 1. Such costs include the expense of construction, engineering, land rights, relocation payments and project administration. The "Watershed Plan Agreement" outlines financial responsibility of sponsoring local organizations and participating federal and state agencies for all categories of structural installation costs. Total structural installation costs are $2,348,910, of which $2,017,434 are PL-566 funds and $331,476 are other funds.

Construction costs consist of the estimated contract cost of all materials, labor and equipment involved in the construction process, plus a contingency allowance for any unexpected expenses which might occur during construction. Cost contingencies of 10 to 12 percent have been added to estimated contract costs for all structural measures. All construction costs are 100 percent PL-566 funds estimated to be $1,585,060.

Engineering cost is the cost of preparing construction plans for the structural measures. Examples of engineering costs are the direct costs of engineers, geologists, and other technicians for construction surveys and investigations, soil and foundation drilling and testing, design, and preparation of plans and specifications. All engineering costs are 100 percent PL-566 funds estimated to be $176,805.

Land rights cost includes all expenditures for 1) flowage easements, fee title acquisition, legal fees, appraisal costs, etc. ($254,940), 2) the closing or modification of private and county roads ($26,000), 3) the purchase or modification of buildings ($500), 4) the modification or removal of utility lines ($5,000), and 5) the construction of a protective levee ($12,500). All land rights costs are 100 percent Other funds estimated to be $298,940.

Relocation payments are applicable to a displaced person, business, and farm operation. These are the PL-566 and Other costs associated with the requirements of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (PL 91-646). The amount includes moving and related

1/ Assisting agency is the U.S. Forest Service
2/ Assisting agency is the Soil Conservation Service.

expenses for a displaced person, business, or farm operation as well as financial assistance for replacement housing for a displaced person who qualifies and where dwelling is acquired because of the project. Such payments will be cost shared in accordance with the ratio of PL-566 funds and Other funds to total costs as shown in Table 1, exclusive of relocation payments costs. Relocation payments are estimated to be $2,500, of which $1,864 are PL-566 funds and $636 are Other funds.

Project administration costs are the administration costs associated with the installation of structural measures. Included are the costs of contract administration, relocation assistance advisory services, review of engineering plans prepared by other, Government Representatives and construction inspection necessary to insure the installation of structural measures in accordance with plans and specifications. These costs are treated as project costs but are not considered as applicable to individual purposes served by the project nor are they a part of the cost of individual measures. Project administration costs are estimated to be $285,605, of which $253,705 are PL-566 funds and $31,900 are Other funds.

Relocation assistance advisory services are not to be confused with other administrative functions associated with relocation payments. The advisory services include such items as (1) determination of needs, (2) obtaining current pertinent information concerning housing programs, costs, etc., (3) developing and handing out brochures, (4) assurance of replacement dwellings, and (5) assisting in getting established. The other administrative functions to be provided as needed include such items as (1) providing by first-class mail written notice of displacement and appropriate application forms to each displaced person, business, or farm operation, (2) assistance in filing applications, (3) reviewing and taking action on applications for assistance, (4) reviewing and processing grievances, and (5) making relocation payments. Relocation assistance advisory services, to be paid by Other funds, are estimated to cost $200.

Schedule of Obligations. The estimated schedule of PL-566 and Other fund obligations for the installation costs of project structural measures is as follows:

Year	PL-566	Other	Total
	(Dollars)		
1	33,289	42,566	75,855
2	367,330	90,070	457,400
3	448,430	51,830	500,260
4	279,750	75,825	355,575
5	448,250	30,640	478,890
6	210,755	36,585	247,340
7	229,630	3,960	233,590
TOTAL	2,017,434	331,476	2,348,910

Should any of the following non-project costs occur, they must be borne by the sponsoring local organizations. These costs are additional items not included in benefit-cost, cost allocation, or cost sharing computations.

Non-project costs include all additional costs resulting from changes of, or additions to, project works of improvement for non-project purposes or maintenance such as (1) additions, modifications, or relocations of project works of improvement to serve non-project purposes, such as altering a dam to permit its use as a roadway, (2) relocation or modification of project works of improvement for the convenience of the sponsoring local organization, (3) acquisition of land rights not required for project purposes, and (4) the added cost of replacing existing railroads and highways with facilities of higher quality or greater performance capabilities.

BENEFITS-MONETARY

The 22 floodwater retarding structures will reduce average annual floodwater damages an estimated 42 percent. In addition, land treatment is expected to reduce average annual damages 6 percent for a total project damage reduction of 48 percent.

Average annual benefits attributable to structural measures are estimated to be $252,664 (Table 6). In addtion, offsite damage reduction benefits to land treatment are estimated at $17,033. Onsite conservation benefits to land treatment measures were not evaluated, as the worth of such measures is widely accepted.

Primary flood prevention benefits to structural measures are estimated as follows: floodwater damage reduction $143,028 changed land use $40,562, and more intensive use $41,094 (Table 6).

Floodwater damage reduction for the project includes reduced crop and pasture damage of $105,415 other agricultural damage reduction of $14,437, nonagricultural damage reduction of $5,193, reduction of flood plain scour damage of $3,154 and a reduction of indirect damage of $31,862 (Table 5). Evaluation of flood reduction benefits was limited to those areas affected by project structural measures. The Hall-Flat Watershed Project will provide some monetary benefits to the 39,800 acres of Patoka River flood plain land downstream from the junction of Straight River. These downstream benefits were not evaluated.

Local secondary benefits attributable to structural measures were estimated at $27,980 (Table 6). Only benefits generated from additional income by the project through increased demands on local suppliers of goods and services and on a local processing, transporting, and marketing facilities were evaluated. Benefits of a secondary nature from a national viewpoint were not considered pertinent and therefore, were not evaluated.

COMPARISON OF BENEFITS AND COSTS

Average annual benefits to structural measures of $252,664 compared to average annual structural cost of $151,196 gives an overall benefit cost ratio of 1.7:1. Excluding local secondary benefits, the benefit cost ratio is 1.5:1.

INSTALLATION PROVISIONS

Land Treatment. The SWCD will assume the responsibility for the application of the land treatment measures. The measures will be installed by private landowners and operators within a seven-year period. The Service will provide personnel to assist the SWCD in providing landowners and operators technical assistance to develop conservation plans and to install planned practices. Technical assistance for the forest land measures will be furnished by the IDNR, Division of Forestry, in cooperation with the USFS.

Structural Measures. The District will have the responsibility for installation, operation and maintenance, and administration of construction contracts for all structural measures. The District has the power of eminent domain and taxation, as provided by the Indiana Conservancy Act, and will use this power as necessary to assure scheduled completion of its portion of the project.

An establishment period will follow each structural measure installed. The term "establishment period" applies only to vegetation installed as a structural measure or associated with more complicated structural measures. The establishment period terminates when the Service notifies the District that vegetative cover is established or after two growing seasons have elapsed since the initial installation of the vegetative measure, whichever occurs first. During the establishment period, the state conservationist may approve PL-566 cost sharing for additional work that is required to obtain adequate vegetative cover. However, this work must be done on the same land area that was originally vegetated. This includes the installation of measures such as small erosion control structures, diversions, or subsurface drains needed to assure the establishment of vegetative cover. Work needed on vegetative measures after termination of the establishment period is considered as maintenance and is the responsibility of the sponsors.

Land rights may be acquired through donation, a mutual agreement to exchange, negotiation of purchase price, or condemnation. Land rights purchased or acquired by negotiation will be appraised by a qualified land appraiser and a prompt offer made in writing for each tract at no less than full appraised value.

As part of project administration, the District will provide such relocation assistance advisory services as may be needed in connection with the displacement of one mobile home. The District will assure that decent, safe, and sanitary housing will be available to all persons displaced by the project. Displaced persons will be given notice to vacate at least 90 days before they are required to move.

The Service will assume responsibility for the engineering design and all construction costs. The Service will also be responsible for construction layout and inspection and consultative assistance to others during contracting and construction. The Service will also assist the project sponsors in fulfilling their relocation assistance advisory service responsibilities.

The IDNR, in accordance with state laws and regulations, will review and approve the plans and specifications for the structural works of improvement to be installed.

All works of improvement will be installed within a seven-year period. Land rights will be acquired on structures numbered 5, 8, 26, and 62 within the first year. Actual alterations of roads, power lines and telephone lines may take place prior to or concurrently with construction of the structural measures involved.

Grouping of several structures into one contract is planned in an effort to (1) reduce the total number of contracts involved, (2) to create an efficient contract unit for bidding, and (3) to more efficiently utilize contracting and inspections personnel. The following yearly construction sequence for the project installation period was selected to involve the whole watershed in construction activities at an early date and to complete structural control on subwatersheds as soon as possible.

Year	Item
1	Land rights for str. nos. 5, 8, 26, and 62.
2.	Land rights for str. nos. 37, 40, and 78. Construction of str. nos. 5, 8, 26, and 62.
3	Land rights for str. nos. 10, 32, 41, and 43. Construction of str. nos. 37, 40, and 78.
4	Land rights for str. nos. 25, 64, and 79. Construction of str. nos. 10, 32, 41, and 43.
5	Land rights for str. nos. 9, 16, 21, and 29. Construction of str. nos. 25, 64, and 79.
6	Land rights for str. nos. 7, 30, 33, and 44. Construction of str. nos. 9, 16, 21, and 29.
7	Construction of str. nos. 7, 30, 33, and 44.

At each of the 22 reservoir sites, as mitigation for the project losses of wildlife habitat, the easement area from the flood pool line to the sediment pool line will be set aside as a wildlife area with appropriate permanent markers. This land would be allowed to undergo natural habitat successional changes from its present condition(s) with the following exceptions:

1. If the current use of a definable area is pasture, livestock access to the pool will be limited to a specially constructed watering area that is fenced, stone walkway, etc.

2. All wooded areas of one-half acre or larger within reservoir flood pools will also be fenced when in association with areas of definable pasture use.

3. If hay cutting has been a regular practice, it should continue within the following dates: June 15 to August 31.

4. Areas disturbed by construction activity and other critical erosion areas will be planted to grasses, legumes, shrubs, trees, or a combination of these plants.

5. If the current use of a definable area is cropland, this practice may continue with the landowner's knowledge that the area is subject to seasonal inundation by the flood pool.

These procedures will accommodate the vast majority of the numerous wildlife species of this watershed area at some stage of succession. This will be done within the land rights necessary for the structural measures.

OPERATION AND MAINTENANCE PROVISIONS

Land Treatment. Land treatment measures will be operated and maintained by the owners and operators of the farms under agreement with the local SWCD. Technical assistance will be provided by the Service. The forest land treatment measures installed on private land will be maintained by the landowners with technical assistance furnished by the IDNR, Division of Forestry, in cooperation with the USFS under the ongoing Cooperative Forest Management Program. The USFS and the IDNR, Division of Forestry, will maintain land treatment measures installed on the Ferdinand State Forest.

Structures. Works of improvement are planned, designed and installed to serve certain purposes. The total benefits to be derived from the installation cannot usually be realized unless the installation is operated and maintained in such a manner that it will serve the purpose, both as to function and time, for which it was installed. An active program for operation and maintenance consists of:

1. an agreed-to plan which provides adequate and sound arrangements for proper operation, timely inspection, prompt and appropriate performance of needed maintenance, financing the costs of operation and maintenance, and the maintaining of records reflecting the actions required and taken, and

2. the carrying out of the provisions of the agreed-to plan in a manner consistent with the spirit, intent, and purpose of the plan and the project.

The District is responsible for the proper operation and management without cost to the Service for the structural measures installed in whole or in part with PL-566 funds and for which will be a continuing need for operation and maintenance.

The Service is responsible for (1) determining that sound arrangements have been made to assume that all structural measures installed in whole or in part with PL-566 funds will be operated and maintained in such a manner as to serve the purpose for which they were installed, (2) determining that sound financial arrangements have been made by the District to defray the costs of operation and maintenance, (3) making appropriate inspections to assure that the structural measures are operated and maintained properly and

that all maintenance indicated by inspection reports is performed, (4) promptly calling to the attention of the District any failure on its part to properly operate and maintain the structural measures as provided in the operation and maintenance agreement, and (5) providing such technical services as required for proper operation and the preparation of plans, designs, and specifications for needed maintenance of the structural measures.

All structures are designed for automatic discharge of floodwater. Average annual operation and maintenance cost for the floodwater retarding reservoirs is $6,950.

Normal operation and maintenance work will consist of such items as:

1. Repairing damage to structural embankments and spillways.

2. Removing trash from the sediment pools and principal spillways.

3. Liming and fertilizing vegetative cover to maintain effective stands.

Major repair may involve such things as (1) repairing separated joints, cracks or breaks in the principal spillway, (2) correcting seepage, (3) replacing significant backfill around structures resulting from major erosion damage, (4) major revegetation due to failure to obtain an adequate vegetative cover, and (5) restoring areas with significant erosion caused by unusual flow (volume, recurrence or extended period of time) in emergency spillways.

The District and Service will jointly inspect each structural measure at least annually and after unusually severe floods or after the occurrence of any other unusual condition that might adversely affect the structural measure. These joint inspections will continue for a three year period ending at midnight on the third anniversary of the date on which the structural measure was accepted. The District will be encouraged to invite representatives of IDNR and the Department of the Interior, U. S. Fish and Wildlife Service (USF&WS) to participate in this inspection. An inspection report will be jointly prepared by the members of the inspection team. A copy will be furnished to each organization or agency participating in the inspection. Follow-up reports will be prepared at regular intervals until all deficiencies noted in the inspection report have been satisfactorily corrected.

After the three year period, the structural measures will be inspected annually and after unusually severe floods by the District. An inspection report will be prepared by the District and a copy furnished to the Service.

As the structural measures are constructed, operation and maintenance funds will be collected. When the project is completed a cumulative fund will be available, equal to or greater than the estimated annual operation and maintenance cost. An operation and maintenance budget will be developed each year to take care of current needs and to maintain the reserve fund.

Operation and maintenance activities will be set forth in the operation and maintenance plan and carried out in a manner to minimize adverse environmental effects.

The operation and maintenance plan will supplement the operation and maintenance agreement executed between the Service and the District, prior to signing a project agreement. The Service's Indiana Watershed Operation and Maintenance Handbook will be used as a basis for the operation and maintenance plan.

It is recommended that a fish and wildlife management section be incorporated in the operation and maintenance plan. This section should be developed by an interdisciplinary team consisting of the following organizations and agencies: the SWCD; the District; IDNR; USF&WS; and the Service.

Mitigation features, such as the fences for livestock exclusion, will be maintained by the District and repaired and replaced when required.

The operation and maintenance agreement will include specific provisions for retention and disposal of property acquired or improved with PL-566 financial assistance.

FINANCING PROJECT INSTALLATION

Land Treatment Measures. Federal assistance for carrying out the works of improvement set forth in this plan will be provided under authority of the Watershed Protection and Flood Prevention Act (PL-566, 83d Congress, 68 Stat. 666) as amended. Federal financial assistance is contingent on the appropriation of funds to carry out this plan.

Technical assistance for installation of all accelerated land treatment on cropland, pastureland, and other land areas will be provided by the Service through PL-566 funds. Cost sharing for installation of these land treatment measures will be provided to landowners and operators through state and federal funds provided under authorities other than PL-566. Farm owners and operators will provide the funds for their share of the installation costs of land treatment measures included in this plan. Loans are expected to be available to landowners from banks, the Production Credit Association, the Farmers Home Administration (FmHA), and business establishments providing goods and services.

The cost of installing the land treatment measures are summarized in Table 1. Such costs total $563,217, of which $177,056 are for technical assistance and $386,161 for application. Technical assistance costs are borne by PL-566 funds ($153,356), funds of other programs administered by the Service ($16,000) and funds administered by IDNR, Division of Forestry, in cooperation with the U. S. Forest Service ($7,700). Application costs for land treatment on private forest land will be borne by watershed landowners and operators ($29,400).

Structural Measures. All necessary land rights for a particular structural measure will be secured before federal financial assistance is made available for the installation of that structural measure. These land rights include, but are not limited to, agreements with county and state road

officials concerning modifications to roads, and fee simple title or easements on land and improvements as required.

The District has analyzed its financial needs in consideration of the scheduled installation of the works of improvement and has made provisions for the ways and means of obtaining the necessary funds. The District has filed a letter of intent with the FmHA stating its desire to obtain a loan to help finance its share of initial project costs.

Invitation to bid on construction of planned structural measures will be issued after the project agreement is executed. This agreement will be executed when PL-566 funds have been appropriated; the contracting agencies have funds available and are prepared to discharge their responsibilities; the necessary land rights have been obtained; the required land treatment in the drainage area above the structural measures has been installed; the construction plans and specifications have been prepared and approved as required; and the operation and maintenance agreements have been executed.

Prior to entering into agreements that obligate funds of the Service, the District will have a financial management system for control, accountability, and disclosure of PL-566 funds received, and for control and accountability for property and other assets purchased with PL-566 funds.

Program income earned during the grant period will be reported on the District's request for advance or reimbursement from the Service.

INSTALLATION COST ITEM	UNIT	NUMBER			ESTIMATED COST (Dollars) 1/						
					PL-566 FUNDS			OTHER FUNDS			TOTAL
		FED. LAND	NON-FED LAND	TOTAL	NON-FEDERAL LAND		TOTAL	NON-FEDERAL LAND		TOTAL	
					SCS 3/	FS 3/		SCS 3/	FS 3/		
LAND TREATMENT											
Land Areas 2/											
Cropland	Ac.		5,500	5,500				94,598		94,598	94,598
Pastureland	Ac.		5,800	5,800				237,450		237,450	237,450
Other land	Ac.		1,375	1,375				24,713		24,713	24,713
Forest land	Ac.		5,350	5,350					29,400	29,400	29,400
Technical Assistance			18,025	18,025	127,856	25,500	153,356	16,000	7,700	23,700	177,056
TOTAL LAND TREATMENT			18,025	18,025	127,856	25,500	153,356	372,761	37,100	409,861	563,217
STRUCTURAL MEASURES											
CONSTRUCTION											
Single Purpose - Floodwater Retarding Structures	No.		22	22	1,585,060		1,585,060				1,585,060
Subtotal Construction					1,585,060		1,585,060				1,585,060
ENGINEERING SERVICES					176,805		176,805				176,805
RELOCATION PAYMENTS					1,864		1,864	636		636	2,500
PROJECT ADMINISTRATION											
Construction Inspection					158,510		158,510				158,510
Other					95,195		95,195	31,700		31,700	126,895
Relocation Assistance Advisory Services								200		200	200
Subtotal Administration					253,705		253,705	31,900		31,900	285,605
OTHER COSTS											
Land Rights								298,940		298,940	298,940
Subtotal Other								298,940		298,940	298,940
TOTAL STRUCTURAL MEASURES					2,017,434		2,017,434	331,476		331,476	2,348,910
TOTAL PROJECT					2,145,290	25,500	2,170,790	704,237	37,100	741,337	2,912,127

1/ Price base : 1975

2/ Includes only areas estimated to be adequately treated during project installation period. Treatment will be accelerated throughout the watershed and dollar amounts apply to total land areas, not just to adequately treated areas.

3/ Federal agency responsible for assisting in installation of works of improvement.

TABLE 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT

(At time of Plan Preparation)

Hall-Flat Creek Watershed, Indiana

Measures	Unit	Applied To Date	Total Cost 1/ (Dollars)
LAND TREATMENT			
Soil Conservation Service			
Conservation Cropping System	Ac.	811	1,517
Contour Farming	Ac.	295	608
Crop Residue Management	Ac.	1,626	2,537
Critical Area Planting	Ac.	12	780
Diversions	Ft.	17,263	8,632
Drainage Field Ditch	Ft.	1,000	500
Drainage Main or Lateral	Ft.	44,482	80,068
Grade Stabilization Structure	No.	26	13,000
Grassed Waterways	Ac.	18	6,300
Holding Ponds and Tanks	No.	18	36,000
Minimum Tillage	Ac.	295	1,015
Pasture Management	Ac.	1,375	41,250
Pasture Planting	Ac.	2,123	159,225
Pond	No.	164	196,800
Spring Development	No.	5	1,500
Subsurface Drain	Ft.	478,537	215,342
Wildlife Upland Habitat Management	Ac.	103	3,863
Forest Service			
Management Plans	Ac.	1,400	4,000
Harvest Cutting	Ac.	320	3,500
T.S.I.	Ac.	180	5,400
TOTAL			781,837

1/ Price Base: 1975

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TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION
Hall-Flat Creek Watershed, Indiana
(Dollars) 1/

Floodwater Retarding Structure No.	Installation Cost - PL-566 Funds				Installation Cost - Other Funds				Total Inst. Costs
	Constr.	Engrg.	Reloc. Pymts.	Total PL-566	Constr.	Land Rights	Reloc. Pymts.	Total Other	
5	86,795	10,415		97,210		4,710		4,710	101,920
7	41,360	4,140		45,500		10,120		10,120	55,620
8	53,540	5,350		58,890		6,580		6,580	65,470
9	40,470	4,050		44,520		4,620		4,620	49,140
10	43,640	4,360		48,000		5,480		5,480	53,480
16	43,360	4,340		47,700		4,960		4,960	52,660
21	32,710	3,270		35,980		8,940		8,940	44,920
25	109,645	13,160		122,805		14,190		14,190	136,995
26	50,910	5,090	1,864	57,864		5,990	636	6,626	64,490
29	48,070	4,810		52,880		4,680		4,680	57,560
30	59,815	5,980		65,795		4,800		4,800	70,595
32	45,990	4,600		50,590		16,400 2/		16,400	66,990
33	46,420	4,640		51,060		7,920		7,920	58,980
37	139,650	16,760		156,410		18,800		18,800	175,210
40	109,005	13,080		122,085		32,950 3/		32,950	155,035
41	63,325	6,330		69,655		17,650		17,650	87,305
43	49,715	4,970		54,685		7,920 4/		7,920	62,605
44	50,360	5,040		55,400		10,450		10,450	65,850
62	87,245	10,470		97,715		24,450 5/		24,450	122,165
64	125,100	15,000		140,100		25,830		25,830	165,930
78	120,450	14,450		134,900		32,750		32,750	167,650
79	137,485	16,500		153,985		28,750 6/		28,750	182,735
Subtotal	1,585,060	176,805	1,864	1,763,729		298,940	636	299,576	2,063,305
Project Administration				253,705				31,900	285,605
GRAND TOTAL	1,585,060	176,805	1,864	2,017,434		298,940	636	331,476	2,348,910

1/ Price base: 1975
2/ Includes $3,000 cost of increasing top width of dam for county road.
3/ Includes $5,000 for removal of utilities and $500 for closing county road.
4/ Includes $2,000 for construction of private road.
5/ Includes $15,000 for construction of county road around reservoir and $500 for removal of existing barn.
6/ Includes $5,000 for construction of private road, $500 for closing of county road, and $12,500 for construction of a levee to protect a house downstream of the dam.

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TABLE 3 - STRUCTURE DATA
STRUCTURES WITH PLANNED STORAGE CAPACITY
HALL-FLAT CREEK WATERSHED, INDIANA

ITEM	UNIT	STRUCTURES										
		5	7	8	9	10	16	21	25	26	29	30
Class of Structure		a	a	a	a	a	a	a	a	a	a	a
Drainage Area	Sq.Mi.	0.78	1.09	0.74	0.48	0.56	0.51	0.74	1.50	0.60	0.50	0.58
Curve No. (1-day)(AMC II)		78	78	78	78	78	78	78	78	78	78	78
Tc	Hrs.	0.4	0.6	0.5	0.4	0.4	0.4	0.5	0.6	0.5	0.4	0.4
Elevation Top of Dam	Ft. (MSL)	539.9	510.3	521.0	525.0	514.5	525.0	497.2	536.7	528.0	533.6	522.4
Elevation Crest Emergency Spillway	Ft. (MSL)	533.5	502.7	514.1 4/	520.2 4/	509.7 4/	520.0 4/	491.0 4/	530.0	522.5 4/	528.7 4/	515.8 4/
Elevation Crest High Stage	Ft. (MSL)	523.3	499.3	509.5	513.4	501.6	513.0	487.6	521.7	515.6	523.2	510.9
Elevation Crest Low Stage	Ft. (MSL)	516.5	495.1	504.9	508.3	496.5	508.1	483.9	516.1	511.1	518.7	504.2
Maximum Height of Dam	Ft.	42	23	26	29	28	30	18	36	25	28	22
Volume of Fill (X1000)	Cu.Yds.	59.6	23.5	37.4	22.4	26.8	25.9	15.1	76.6	35.7	29.6	42.9
Total Capacity	Ac.Ft.	203	169	135	125	133	122	145	424	140	126	97
Sediment Submerged 100 years	Ac.Ft.	48	36	32	30	21	27	46	114	26	36	22
Sediment Areated	Ac.Ft.	6	5	4	4	3	3	6	14	3	4	3
Retarding	Ac.Ft.	149	128	99	91	109	92	93	296	111	86	72
Between High and Low Stage	Ac.Ft.	42	58	39	26	30	27	39	79	32	27	31
Surface Area												
Sediment Pool	Ac.	5.6	11.3	7.4	4.5	5.0	5.1	9.6	14.3	6.7	5.5	3.7
Retarding Pool	Ac.	13.4	22.4	14.5	12.1	11.9	11.0	18.1	32.9	13.3	13.0	10.1
Principal Spillway												
Runoff Volume (10 day) 1/	In.	7.70	4.55 3/	4.55 3/	4.55 3/	4.55 3/	4.55 3/	4.55 3/	7.70	4.55 3/	4.55 3/	4.55 3/
Capacity of Low Stage	c.f.s.	3	4	3	2	2	2	3	6	2	2	2
Capacity of High Stage	c.f.s.	35	19	22	26	25	25	21	63	23	24	26
Frequency Operation-Em. Spillway	% chance	4	10	10	10	10	10	10	4	10	10	10
Size of Conduit	In.	18	16	16	16	16	16	16	24	16	16	16
Emergency Spillway												
Rainfall Volume (ESH)(Areal)	In.	4.60	4.60	4.60	4.60	4.60	4.60	4.60	4.60	4.60	4.60	4.60
Runoff Volume (ESH)	In.	2.37	2.37	2.37	2.37	2.37	2.37	2.37	2.37	2.37	2.37	2.37
Storm Duration	Hrs.	6	6	6	6	6	6	6	6	6	6	6
Type		veg.	veg.	veg.	veg.	veg.	veg.	veg.	veg.	veg.	veg.	veg.
Bottom Width	Ft.	20	20	20	20	20	20	20	20	20	20	20
Velocity of Flow (Ve)	Ft./Sec.	--	6.00	4.86	--	--	--	4.86	--	--	--	4.92
Slope of Exit Channel	Ft./Ft.	.020	.031	.037	.022	.022	.021	.037	.020	.021	.022	.036
Maximum Water Surface Elevation	Ft. (MSL)	531.9	504.3	515.4	519.0	508.3	519.2	492.3	528.4	521.7	528.4	517.7
Freeboard												
Rainfall Volume (ESH)(Areal) 2/	In.	13.29	13.29	13.29	13.29	13.29	13.29	13.29	13.29	13.29	13.29	13.29
Runoff Volume (ESH)	In.	10.41	10.41	10.41	10.41	10.41	10.41	10.41	10.41	10.41	10.41	10.41
Storm Duration	Hrs.	6	6	6	6	6	6	6	6	6	6	6
Maximum Water Surface Elevation	Ft. (MSL)	539.9	510.1	521.0	525.0	514.4	525.0	497.2	536.7	528.0	533.6	522.4
Capacity Equivalents												
Sediment Volume	In.	1.30	0.71	0.91	1.33	0.80	1.10	1.32	1.60	0.91	1.50	0.81
Retarding Volume	In.	3.58	2.20	2.51	3.55	3.65	3.38	2.36	3.70	3.47	3.23	2.33

1/ Method 2, Chapter 21, Section 4, Hydrology Guide, (Rev. January 1971)
2/ Exceeds SCS Engineering Memorandum 27 minimum to comply with IDNR criteria.
3/ Designed with ten year rainfall as outlined in Engineering Memorandum - Indiana 7 (Rev.3) where product of storage times effective height is less than 3000.
4/ Emergency spillway raised to exceed the minimum requirements of Engineering Standards 402-1.

TABLE 3 - STRUCTURE DATA
STRUCTURES WITH PLANNED STORAGE CAPACITY
HALL-FLAT CREEK WATERSHED, INDIANA

ITEM	UNIT	STRUCTURES											
		32	33	37	40	41	43	44	62	64	78	79	TOTAL
Class of Structure		a	a	a	a	a	a	a	a	a	a	a	
Drainage Area	Sq.Mi.	0.93	0.51	2.28	2.78	1.14	0.50	0.53	1.14	2.67	2.62	1.94	25.12
Curve No. (1-day)(AMC II)		78	78	78	78	78	78	78	78	78	78	78	
Tc	Hrs.	0.7	0.5	0.9	0.8	0.7	0.4	0.4	0.64	0.71	0.54	0.85	
Elevation Top of Dam	Ft. (MSL)	499.5	490.9 4/	545.0	534.5	486.7	508.9 4/	500.1 4/	546.9	515.9	523.0	573.5	
Elevation Crest Emergency Spillway	Ft. (MSL)	493.2	486.9 4/	537.8	527.7	480.0	504.3 4/	496.3 4/	540.9	509.1	516.8	566.3	
Elevation Crest High Stage	Ft. (MSL)	490.6	479.9	526.3	518.3	478.2	496.9	489.7	530.4	500.5	509.7	555.4	
Elevation Crest Low Stage	Ft. (MSL)	487.1	475.9	518.9	512.1	475.1	492.8	486.5	523.8	495.4	504.8	547.0	
Maximum Height of Dam	Ft.	22	23	40	36	23	24	20	37	31	29	46	
Volume of Fill (X1000)	CuYds.	30.1	30.6	115.3	69.6	43.0	32.9	34.1	59.6	88.3	86.0	97.8	1,082.8
Total Capacity	Ac.Ft.	166	138	581	702	195	135	151	300	684	624	425	5,920
Sediment Submerged 100 years	Ac.Ft.	53	19	77	119	76	26	20	54	113	110	82	1,187
Sediment Aerated	Ac.Ft.	6	2	10	15	9	3	3	7	13	13	10	146
Retarding	Ac.Ft.	107	117	494	568	110	106	128	239	558	501	333	4,587
Between High and Low Stage	Ac.Ft.	50	27	122	148	61	27	28	61	142	140	103	1,339
Surface Area													
Sediment Pool	Ac.	13.2	5.6	12.8	20.3	18.1	6.4	7.3	8.3	24.1	23.9	10.6	229.3
Retarding Pool	Ac.	24.3	16.6	43.6	57.7	30.0	13.0	18.9	21.9	59.6	65.8	27.8	551.9
Principal Spillway													
Runoff Volume (10 day) 1/	In.	4.55 3/	4.55 3/	7.70	7.70	4.55 3/	4.55 3/	4.55 3/	7.70	7.70	7.70	7.70	
Capacity of Low Stage	c.f.s.	4	2	9	11	5	2	2	5	11	10	8	
Capacity of High Stage	c.f.s.	19	22	67	107	46	21	20	38	100	149	135	
Frequency Operation-Em. Spillway	% chance	10	10	4	4	10	10	10	4	4	4	4	
Size of Conduit	In.	16	16	24	30	24	16	16	18	30	36	30	
Emergency Spillway													
Rainfall Volume (ESH)(Areal)	In.	4.60	4.60	4.60	4.60	4.60	4.60	4.60	4.60	4.60	4.60	4.60	
Runoff Volume (ESH)	In.	2.37	2.37	2.37	2.37	2.37	2.37	2.37	2.37	2.37	2.37	2.37	
Storm Duration	Hrs.	6	6	6	6	6	6	6	6	6	6	6	
Type		veg.	veg.	veg.	veg.	veg.	veg.	veg.	veg.	veg.	veg.	veg.	
Bottom Width	Ft.	20	20	30	50	20	20	20	30	40	50	50	
Velocity of Flow (Ve)	Ft./Sec.	5.43	--	--	--	5.77	--	--	--	--	--	--	
Slope of Exit Channel	Ft./Ft.	.034	.024	.019	.020	.032	.023	.024	.021	.020	.020	.019	
Maximum Water Surface Elev.	Ft. (MSL)	494.7	484.9	535.2	525.8	481.8	502.6	494.1	538.6	507.2	515.6	565.1	
Freeboard													
Rainfall Volume (ESH)(Areal) 2/	In.	13.29	13.29	13.29	13.29	13.29	13.29	13.29	13.29	13.29	13.29	13.29	
Runoff Volume (ESH)	In.	10.41	10.41	10.41	10.41	10.41	10.41	10.41	10.41	10.41	10.41	10.41	
Storm Duration	Hrs.	6	6	6	6	6	6	6	6	6	6	6	
Maximum Water Surface Elevation	Ft. (MSL)	499.5	490.9	545.0	534.5	486.7	508.9	500.1	546.9	515.9	523.0	573.5	
Capacity Equivalents													
Sediment Volume	In.	1.19	0.77	0.72	0.90	1.40	1.09	0.81	1.00	0.88	0.88	0.89	
Retarding Volume	In.	2.16	4.30	4.06	3.83	1.81	3.98	4.53	3.93	3.92	3.59	3.22	

1/ Method 2, Chapter 21, Section 4, Hydrology Guide, (Rev. January 1971)
2/ Exceeds SCS Engineering Memorandum 27 minimum to comply with IDNR criteria.
3/ Designed with ten year rainfall as outlined in Engineering Memorandum - Indiana 7 (Rev. 3) where product of storage times effective height is less than 3000.
4/ Emergency spillway raised to exceed the minimum requirements of Engineering Standards 402-1.

TABLE 4 - ANNUAL COST

Hall-Flat Creek Watershed, Indiana

(Dollars) 1/

Evaluation Unit	Amortization Installation Cost 2/	Operation and Maintenance Cost	Total
All Structural Measures	126,707	6,950	133,657
Project Administration	17,539	: : : : : : :	17,539
GRAND TOTAL	144,246	6,950	151,196

1/ Price base: Installation and O&M 1975
2/ 100 years at 6 1/8 percent interest.

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TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS

Hall-Flat Creek Watershed, Indiana

(Dollars) 1/

Item	Estimated Average Annual Damage Without Project	With Project	Damage Reduction Benefit
Floodwater			
Crop and Pasture	250,766	145,351	105,415
Other Agricultural	25,187	10,750	14,437
Nonagricultural			
Road and Bridge	7,985	2,792	5,193
Subtotal	283,938	158,893	125,045
Floodplain Scour	7,507	4,353	3,154
Indirect	48,187	16,325	31,862
TOTAL	339,632	179,571	160,061

1/ Price Base: Current normalized prices as approved by Water Resources Council - November 1975 for agricultural items and 1975 prices for other items.

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TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Hall-Flat Creek Watershed, Indiana
(Dollars)

Evaluation Unit	AVERAGE ANNUAL BENEFITS 1/					Avg. Annual Cost 3/	Benefit Cost Ratio
	Damage Reduction	Changed Land Use	More Intensive Use	Secondary	Total Benefit		
All Structural Measures	143,028	40,562	41,094	27,980	252,664	133,657	1.9:1
Project Administration	: : :	: : :	: : : :	: : : :	: : : :	17,539	: : : :
GRAND TOTAL	143,028 2/	40,562	41,094	27,980	252,664	151,196	1.7:1

1/ Price base: Current normalized prices as approved by Water Resources Council - November 1975 for agricultural items and 1975 prices for other items.

2/ In addition, it is estimated that land treatment will provide flood damage reduction benefits of $17,033 annually.

3/ From Table 4.

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ADDENDUM

to the

HALL-FLAT CREEK WATERSHED PLAN

Dubois County, Indiana

This addendum is in response to the established Principles and Standards of the Water Resources Council and has been developed in accordance with the USDA Procedures for Planning Water and Related Land Resources.

Information included consists of:

I. Evaluation of Plan with Current Installation Costs and Discount Rate

II. Abbreviated Environmental Quality Plan

III. Selected Plan - Display Tables

PRINCIPLES AND STANDARDS PHASE-IN ADDENDUM

HALL-FLAT CREEK WATERSHED, INDIANA

I. EVALUATION OF PLAN WITH CURRENT CONSTRUCTION COST AND DISCOUNT RATE

This addendum shows project cost based on 1975 price base for construction costs amortized for 100 years at 6 1/8 percent interest.

Benefits for this addendum are based on current normalized prices for agricultural commodities, as approved by Water Resource Council November 1975, and 1975 prices for other items.

Annual project benefits, costs, and benefit-cost ratio are as follows:

Total benefits	$252,664
Total costs	$151,196
Benefit-cost ratio	1.7:1.0
Benefit-cost ratio without secondary	1.5:1.0

HALL-FLAT CREEK WATERSHED

II. ABBREVIATED ENVIRONMENTAL QUALITY PLAN

ENVIRONMENTAL PROBLEMS

Land Quality

Inherent low fertility and very severe erosion are problems characteristic of approximately 35,376 acres, or 82 percent of the watershed soils. An estimated 11,112 acres of these soils are under cultivation, with one year out of three devoted to row crop production.

Sheet erosion is active throughout the watershed's rolling upland and is the primary sediment source. Approximately 87 percent of watershed soils have erosion hazards. Soil losses on cropland in the upland range between 3 and 10 tons per acre per year. Sheet erosion rates can run as high as 26 tons per acre per year on steep soils that are plowed and planted to continuous row crops. Erosion rates on upland pastureland and grazed forest land range typically between three and seven tons per acre per year.

Gully erosion is prevalent in isolated areas throughout the watershed. Areas affected are the more steeply rolling uplands, and are primarily idle land, cropland, or pastureland. Gully erosion rates range between 20 and 35 tons of soil per acre annually.

Approximately 65 acres of critically eroded land exist within the watershed. This figure includes areas of gully erosion, rill erosion, and severe sheet erosion, which occur on small, steep upland plots that range in size from 1 to 15 acres.

An estimated 381 acres are seriously affected by flood plain scour. All of the flood plain soils are affected to some degree due to floodwaters. Average annual damages from flood plain scour are estimated at $7,507.

Streambank erosion also occurs throughout the watershed, due in part to debris blocks or large, fallen trees. It is not considered serious.

Total gross erosion on the watershed averages 222,719 tons per year. Overall watershed erosion is approximately 98 percent attributable to sheet erosion, 1.5 percent to gully erosion, and 0.5 percent to streambank erosion and flood plain scour.

Floodwater Damage

Damages to crops, pastures, other agriculture properties, roads, and bridges are the principal floodwater problems in the watershed. These

problems are associated with storms which generally occur two to three times per year. Twenty-nine percent of these flood producing storms occur during May, June, and July when crops are most susceptible to damage.

The agricultural flood plain covers 4,381 acres and includes 3,344 acres of cropland valued at approximately $3,190,000.

Farmers have reported crop losses ranging from 20 percent up to 100 percent from the most severe floods.

The food producing capability of these flood plain soils is not realized because of flooding. Farmers cannot economically manage these soils for their potential due to the risk of flood damage.

Based on the monthly probability of flood occurrence, crop and pasture damages for future conditions without project are estimated at $115,994 for the 1-year flood, $161,119 for the 10-year flood, and $187,635 for the 100 year flood (floods that have a statistical probability of occurring once in 1, 10, and 100 years respectively).

Time and expense are involved in removing debris from flood plain areas, repairing fences, farm roads, and tile outlets, removing sediment from drainage ditches and controlling weed infestations carried in by floodwaters.

Interruption of travel, mail, and school bus service, and delay and inconvenience in feeding livestock are problems during flood periods.

Flood damage occurs to county roads and bridges in the watershed. Bridge foundations are undercut by floodwaters and in some cases are rendered unsafe for vehicular use. Road and bridge repairs are expensive and often travel is interrupted until such repairs are made.

Sediment Damage

Sediment damage occurs predominately in the upper reaches of watershed tributary streams. Channels in these areas fill with gravel and sand at gradient breaks. Farm operators have had to remove sediment accumulations from these channels to prevent excessive flooding and raising ground water levels on adjoining lands.

Sand and silt are deposited in the larger drainageways causing channel flow restrictions and increasing the amount of flooding.

Of the 222,719 tons per year of gross erosion, an estimated 22,272 tons are washed from the watershed into the Patoka River annually.

Plant and Animal Resources

Cropland acreages are increasing slightly. Most of the increase is

occurring on flood plain lands where forest land is being converted to cropland. Wildlife habitat of forest land-pastureland "edge" is increasing. This benefits species such as quail and rabbits. Forest land-cropland "edge" is decreasing. This will be detrimental to species such as bob-white quail, cottontail rabbit, and fox squirrel.

Spring and summer flooding destroys eggs and the young of ground nesting animals and birds. This sometimes results in the loss of a complete year of a species in flooded areas. The effects on fish by sediment laden floodwater and the decrease in water quality have not been specifically evaluated.

Wildlife habitat for upland game and song birds is above Indiana's average for quantity and distribution.

Waterfowl in the area is very limited. This watershed is in an area of the state that has the lowest annual harvest of waterfowl.

Recreation

Public recreation within the watershed is deficient in nearly all aspects. However, the proximity of this watershed to several nearby developments affords recreational opportunities for camping, boating, swimming, hiking, and picnicking. These existing facilities along with those planned in the adjacent Anderson River Watershed and those at Patoka Lake adequately fulfill the recreational needs.

Land Use Planning

Current and projected population increases are resulting in continuing land and space competition. The resulting stress on the natural resources points out the need for land use planning to provide for the orderly development of the watershed area.

Authority has been delegated to counties by the state to develop and implement their own land use plan. Dubois County has not developed such a plan.

COMPONENT NEEDS

1. Protect land quality by reducing sheet, gully, and channel erosion.
2. Provide floodwater damage reduction to cropland, pastureland, other agricultural properties, roads, and bridges.
3. Reduce sediment concentrations in streamflows.
4. Management and enhancement of wildlife resources.
5. Improve the present level of surface water quality.
6. Develop and implement comprehensive land use plans at local and regional levels of concern.

Plan Elements

1. Implement conservation land treatment practices and measures that will adequately treat an additional 18,025 acres and partially treat other acres during the project installation period. This land treatment will be voluntarily applied by landowners throughout the entire watershed and will supplement the ongoing land treatment program. Total estimated cost is $563,217.

   Land treatment measures to be applied to 5,500 acres of cropland include contour farming, grade stabilization structures, subsurface drains, drainage field ditches, diversions, grassed waterways, terraces, and conservation cropping systems.

   Land treatment measures to be applied to 5,800 acres of pastureland include pasture and hayland management, pasture and hayland planting, ponds, and spring development.

   Land treatment to be applied to 5,350 acres of private forest land includes development of forest management plans, tree planting, hydrologic stand improvement, and protection from woodland grazing.

2. Install 22 single purpose floodwater retarding reservoirs. Total estimated cost of installation is $2,348,910.

3. Apply wildlife upland habitat management to cropland, pastureland, and forest land where applicable.

4. Vegetate critically eroded areas with erosion controlling species to trees, shrubs, vines, grasses, and legumes.

5. Identify and protect environmentally sensitive areas.

6. Give guidance to residential, industrial, and agricultural developments so that environmental conflicts are minimized.

7. Identify and protect or preserve historical, cultural, and scenic values.

8. Protect the agricultural, food producing base of the area from developments and other uses.

   Dubois County currently has not developed a land use plan, even though the authority exists. Such a plan is beyond the scope of this study.

INSTITUTIONAL ARRANGEMENTS

Institutional arrangements and legal entities of government are in existence for the implementation of the Environmental Quality Plan. Local, state, and federal programs are available to provide the needed financial assistance.

Local Programs and Sources

1. Hall-Flat Creek Conservancy District is responsible for all or part of the following costs:

   a. Land rights.
   b. Local contract administration and relocation advisory assistance.
   c. Relocation.

2. Farmers Home Administration, local banks, and Production Credit Association - loans to landowners for their share of installing land treatment measures and practices.

3. State Programs and Assistance

   a. Forestation Program - tree planting stocks and technical assistance.
   b. Private Land Wildlife Habitat Improvement Program - financial and technical assistance to create wildlife habitat on private lands.
   c. Natural Resource Funds - financial assistance for developing fish and wildlife habitat and recreational areas.
   d. Conservation Officer - enforcement of game laws.
   e. Primary responsibility for the protection, management, and utilization of the forest resources of the state.
   f. Responsibility for state-wide fire protection on both state and private forest lands.
   g. Provide technical advice and assistance to private woodland owners and primary wood using industries.
   h. Outdoor Recreation Division - land acquisition and development of recreational facilities.

Federal Programs and Assistance

1. U.S. Department of Agriculture

   a. Resource Conservation and Development - financial and technical assistance involving human and natural resources. Dubois County is within the Four Rivers RC&D Project area.
   b. Agricultural Conservation Program - cost sharing assistance to individual landowners for application of conservation practices.
   c. Loans and Advances - loans and advances to sponsoring organizations.
   d. Funds for wildlife habitat improvement, watershed protection, and timber stand improvement.

2. U.S. Department of the Interior

   a. Pitman-Robertson Funds - wildlife research and financial and technical assistance in developing wildlife habitat areas, administered by the state.
   b. Dingell-Johnson Funds - fishery research and financial and

technical assistance in developing fishery habitat areas, administered by the state.

c. Land and Water Conservation Fund - (1) acquisition of land for federally administered recreation areas and (2) matching grants for state recreation planning and state as well as local land acquisition and development.

Technical assistance including educational and onsite assistance is available from:

1. Dubois County Soil and Water Conservation District
2. Cooperative Extension Service
3. Indiana Department of Natural Resources
4. USDA, Soil Conservation Service
5. USDA, Forest Service
6. USDI, U.S. Fish and Wildlife Service

EFFECTS

Installing Land Treatment Measures

1. Reduce annual erosion rate in uplands from an estimated 5.6 tons per acre to 4.8 tons per acre, a 14 percent reduction.

2. Improve quality and productivity of approximately 3,500 acres of pastureland.

3. Improve the quality of wildlife habitat by constructing 50 farm ponds.

4. Reduce sediment concentration in streams by 14 percent.

5. Improve wildlife habitat and populations by less intensive use of 3,000 acres of cropland.

6. Aesthetic and scenic values will be enhanced by the pleasing beauty and land contrasts of a well managed land environment.

7. Increase land devoted to wildlife by 170 acres.

8. Stabilize 35 acres of critically eroding land.

9. Improve wood duck nesting habitat with water impoundments associated with forest land.

10. Reduce average annual flood damages by approximately 6 percent.

11. Improve quality and productivity on approximately 5,350 acres of private forest land.

Installing Floodwater Retarding Structures

1. Reduce average annual flood damages by 42 percent.
2. Reduce flood plain scour erosion damages on 381 acres by an estimated 42 percent.
3. Reduce sediment concentrations in streams by 32 percent.
4. Increase agricultural production potential on flood plain soils.
5. Reduce wildlife losses due to flooding.
6. Create 229 acres of surface water in sediment pools, of which 76 acres are forest land.
7. Periodically inundate 323 acres with flood pools, of which 121 acres are forest land.
8. Create type 3 wetland on 10-15 percent of surface area of the sediment pools.

Reduction of Sediment Damage

1. Improve quality of water by reducing sediment concentration by 46 percent.
2. Reduce amount of sediment that is washed into the Patoka River.
3. Reduce damages to roads and bridges.

Managing Wildlife Habitat and Resources

1. Increase the numbers of wildlife by applying land treatment measures and increase the area of wildlife habitat by 170 acres.
2. Increase fish and aquatic wildlife habitat with 229 acres of water in sediment pools.
3. Increase waterfowl habitat.
4. Reduce flood risk to ground nesting species on the flood plain.

Surface Water Quality

1. Sediment concentrations in streams will be reduced by 46 percent.
2. Agricultural chemicals associated with sediment particles will be reduced by 46 percent in streams.

Developing and Implementing a Land Use Plan

1. Enhance the opportunity for academic, cultural, and recreational

pursuits.

2. Preserve and protect archeological, historical, cultural, and scenic values identified in the area.

3. Guide residential, industrial, and agricultural development in a manner that will reduce conflict with environmental values.

4. Improve living conditions by providing for waste and sewage treatment.

III. SYSTEM OF ACCOUNTS DISPLAY

The following tables illustrate beneficial and adverse effects of the selected plan for Hall-Flat Creek Watershed in the National Economic Development, Regional Development, Social Well-Being and Environmental Quality Accounts.

HALL-FLAT CREEK WATERSHED

SELECTED PLAN - NATIONAL ECONOMIC DEVELOPMENT ACCOUNT

-Addendum-

Components	Measures of Effects Average Annual
Beneficial Effects	
A. The value of users of increased outputs of goods and services.	
1. Flood prevention	$224,684
TOTAL BENEFICAL EFFECTS	$224,684

Components	Measures of Effects Average Annual
Adverse Effects	
A. The values of resources required for a plan.	
1. Twenty two floodwater retarding structures.	
Project installation 1/ (structural measures)	$126,707
Project administration 1/	17,539
Operation and Maintenance (O&M)	6,950
TOTAL ADVERSE EFFECTS	$151,196
NET BENEFICIAL EFFECTS	$ 73,488

1/ Amortized at 6 1/8 percent interest for 100 years.

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HALL-FLAT CREEK WATERSHED

SELECTED PLAN - REGIONAL DEVELOPMENT ACCOUNT

Components	Measures of Effects	
	Indiana	Rest of Nation
B. Employment		
Beneficial effects		
1. Increase in the number and types of jobs.		
a. Agricultural employment	5 seasonal semiskilled jobs-3 permanent semiskilled jobs.	none
b. Employment O&M	2 seasonal semiskilled jobs.	none
c. Employment for project construction	80 semiskilled and skilled jobs for 1 year.	none
TOTAL BENEFICIAL EFFECTS	3 permanent semiskilled jobs. 7 seasonal semiskilled jobs. 80 semiskilled and skilled jobs for 1 year.	

Components	Measures of Effects	
	Indiana	Rest of Nation
B. Employment		
Adverse effects		
1. Decrease in number and type of jobs.		
a. Reduction in road and bridge damage	3 seasonal semiskilled jobs	none
TOTAL ADVERSE EFFECTS	3 seasonal semiskilled jobs.	none
NET BENEFICIAL EFFECTS	3 permanent semiskilled jobs. 4 seasonal semiskilled jobs. 80 semiskilled and skilled jobs for 1 year.	none

HALL-FLAT CREEK WATERSHED

SELECTED PLAN - REGIONAL DEVELOPMENT

Components	Measures of Effects	
	State of Indiana	Rest of Nation
A. Income Beneficial effects		
1. The value of increased output of goods and services to users residing in the region.		
a. Flood prevention	$224,684	0
b. Secondary	27,980	0
TOTAL BENEFICIAL EFFECTS	$252,664	0

Components	Measures of Effects	
	State of Indiana	Rest of Nation
A. Income Adverse effects		
1. The value of resources contributed from within the region to achieve the outputs.		
a. Flood prevention reservoirs.		
Project construction 1/	$18,397	$108,311
Project administration 1/	1,958	15,580
O&M	6,950	0
TOTAL ADVERSE EFFECTS	27,306	123,890
NET BENEFICIAL EFFECTS	+225,358	-123,890

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1/ Amortized at 6 1/8 percent interest for 100 years.

HALL-FLAT CREEK WATERSHED

SELECTED PLAN - REGIONAL DEVELOPMENT ACCOUNT

Components	Measures of Effects	Rest of Nation
C. Population Distribution		
Beneficial effects	Created a net increase of 3 permanent semiskilled jobs, 4 seasonal semiskilled jobs and 80 skilled and semiskilled jobs for 1 year, in an area of below state average income.	none
Adverse effects	none	none
D. Regional Economic Base and Stability		
Beneficial effects	Provides 3 permanent jobs and 5 seasonal jobs in agricultural and agricultural related industries in a county where 41% of the farmers have off farm jobs. Provides 2 additional seasonal and 80 jobs for 1 year where 7.2% of the families have incomes below the national poverty level.	none

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-Addendum-

-Addendum-

HALL-FLAT CREEK WATERSHED

SELECTED PLAN - SOCIAL WELL BEING ACCOUNT

Components	Measures of effects
Beneficial and adverse effects:	
A. Real income distribution	1. Create 3 permanent and 7 seasonal low to medium income jobs for area residents.
	2. Create regional income benefit distribution of $252,664 by income class as follows:

Income class (dollars)	Percentage of Adjusted Gross Income in class	Percentage Benefits in Class
Less than 3,000	7	3
3,000 - 10,000	50	45
More than 10,000	43	52

3. Local Costs to be borne by the region total $27,306 with distribution by income class as follows:

Income class (dollars)	Percentage of Adjusted Gross Income in class	Percentage Contributions in class
Less than 3,000	7	2
3,000 - 10,000	50	44
More than 10,000	43	54

B. Life, health, and safety

1. Provide less restriction to travel and communication in the watershed.

2. Provide increased grain production in a feed deficit area. Increased income will be multiplied by feeding grain to livestock.

3. Reduces the opportunity for flood related accidents and loss of life.

4. Reduce overall flood damages by 48 percent.

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HALL-FLAT CREEK WATERSHED

SELECTED PLAN - ENVIRONMENTAL QUALITY ACCOUNT

Components	Measures of Effects
Beneficial and Adverse Effects	
A. Areas of Natural Beauty	1. Reduce gross erosion in the watershed area by 46% through land treatment and structural measures.
	2. Stabilize 35 acres having a critical erosion problem.
	3. Initially create 229 acres of surface water that will be replaced with sediment over the 100-year evaluation period.
	4. Periodically create 323 acres of temporary surface water.
	5. Inundate approximately 7.1 miles of ephemeral feeder streams.
	6. Enhance physical appearance on 4,381 acres of agricultural lands by reducing sediment and debris deposition and flood plain scour.
	7. Improve the beauty of the land by construction of farm ponds, improved grasslands, contour strip cropping and other farm conservation measures.
	8. Increase aesthetic value of water in watershed streams by reducing sediment concentration by 46 percent.
B. Quality Considerations of Water, Land and Air Resources	1. Reduce sediment concentrations in stream flows by 46 percent (14 percent by land treatment; 32 percent by reservoir sediment pools).

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2. Create 22 small lakes for limited fishing. The volume of water available for fishing will decline as the lakes fill will sediment over the 100-year evaluation period.

3. Stabilize 35 acres having critical erosion problems.

4. Adequately treat 18,025 additional acres bringing the total to 37,480 acres (87%) of the watershed lands.

5. Reduce average annual flood damages by 48 percent.

6. Reduce erosion on 16,650 acres of cropland, grassland, and forest land.

7. Reduce flood plain scour on 381 acres of flood plain soils now having a serious problem.

8. Increase erosion and sedimentation, air pollution, and noise pollution during the 7-year construction period.

9. Reduce the inflow of fertilizers, pesticides, and animal wastes into watershed streams.

C. Biological Resources and Selected Ecosystems

1. Inundate approximately 7.1 miles of ephemeral feeder streams.

2. Create 229 acres of fish and other aquatic habitat. The surface area of the lakes will decline as they fill with sediment over the 100-year evaluation period.

3. Periodically create 323 acres of aquatic wildlife habitat in flood pool areas.

4. Increase the value of stream waters to wildlife and fish by a 46 percent reduction of sediment load.

5. Increase upland wildlife and recreation area by 170 acres.

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6. Benefit upland wildlife by less intensive use of erosive cropland.

7. Create type 3 wetland on 10-15% of the surface area of the sediment pools.

8. Temporarily disrupt wildlife during construction.

9. Implement wildlife habitat management and development plans on 65 acres.

10. Create 50 farm ponds complementing pasture enterprises and enhancing fish and wildlife values.

D. Irreversible or Irretrievable Commitments

1. Inundate 229 acres of cropland, pastureland, and forest land, as well as 7.1 miles of ephemeral streams in sediment pool areas.

2. Change land use of 54 acres of forest land, pastureland and cropland to dams and emergency spillways.

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USDA-SCS-EIS-WS-(ADM)-75-3-(F)-IN

Hall-Flat Creek Watershed
Dubois County, Indiana

FINAL ENVIRONMENTAL IMPACT STATEMENT

Cletus J. Gillman
State Conservationist
Soil Conservation Service

Sponsoring Local Organizations

Dubois County Soil and Water Conservation District
Jasper, Indiana 47546

Hall-Flat Creek Conservancy District
Jasper, Indiana 47546

April 1976

PREPARED BY

UNITED STATES DEPARTMENT OF AGRICULTURE

Soil Conservation Service

Indianapolis, Indiana 46224

USDA ENVIRONMENTAL IMPACT STATEMENT

Hall-Flat Creek Watershed Project
Dubois County, Indiana

Prepared in Accordance with
Sec. 102(2)(C) of P.L. 91-190

SUMMARY

I. Final

II. Soil Conservation Service

III. Administrative

IV. Description of Action: A project for watershed protection and flood prevention in Dubois County, Indiana to be implemented under authority of the Watershed Protection and Flood Prevention Act (PL-566, 83d Congress, 68 Stat. 666), as amended.

The Hall-Flat Creek Watershed Plan consists of land treatment on an additional 18,025 acres and 22 single purpose flood retarding structures.

V. Summary of Environmental Impacts: Reduce annual erosion from 222,719 tons to 191,879 tons per year, a 14 percent reduction by installing land treatment measures. Reduce sediment concentrations in stream flows by 14 percent by installing land treatment measures. Reduce sediment concentrations in stream flows an additional 32 percent with structural measures, for a total 46 percent reduction. Stabilize 35 acres having critical erosion problems. Implement wildlife habitat management and development plans on 170 acres. Create 50 farm ponds, complementing pasture enterprises and enhancing fish and wildlife values. Reduce watershed flood damages by approximately 6 percent with land treatment measures. Reduce watershed flood damages 42 percent with structural measures. Reduce flood plain scour on 381 acres. Reduce the inflow of fertilizers, pesticides, and animal wastes into watershed streams. Create 229 acres of open water beneficial to fish and wildlife. Create an uplift in the overall watershed economy through secondary business supported activities generated by the project. Periodically create 323 acres of aquatic wildlife habitat in flood pool areas. Increase benefits to upland wildlife by less intensive use of erosive cropland. Create type 3 wetland1/ on 10-15 percent of the surface area of the sediment pools.

1/ U.S. Department of Agriculture, Soil Conservation Service. Limiting Technical Assistance for Drainage. Inter-Agency Programs Memorandum-8, Indiana Supplement 1, Indianapolis, Indiana, March 1966 (Memo 8 contains U.S. Department of the Interior, Fish and Wildlife Service Circular 39 - Wetlands of the United States).

Adequately treat 18,025 additional acres bringing the total to 37,480 acres (87 percent) of the watershed lands. Eliminate agricultural use of 141 acres in cropland, 66 acres in pastureland, and 76 acres in forest land in dam, emergency spillway, and sediment pools of planned structures. Produce local area reductions in the amount of wildlife habitat available through the inundation of 229 acres in structure sediment pools (includes 123 acres of cropland, 52 acres of pastureland, and 54 acres of forest land). Interrupt pasturing activities and wildlife use on 64 acres of pastureland in structure flood pool areas and wildlife use on an additional 121 acres of forest land. Inundate approximately 7.1 miles of ephemeral feeder streams within sediment pools of the structures.

VI. List of Alternatives

1. No project
2. Land treatment only.
3. Combination of accelerated land treatment and flood plain zoning.
4. Combination of 28 reservoirs, 11.4 miles of channel work, and land treatment.
5. Other combinations of reservoirs, channel, and land treatment.

VII. Agencies From Which Comments Have Been Received:

1. Department of the Army.
2. Department of Health, Education, and Welfare.
3. Department of the Interior.
4. Environmental Protection Agency.
5. Indiana Department of Natural Resources (for Governor).
6. Patoka Lake Regional Planning Commission.
7. Ohio River Basin Commission.

VIII. Draft Statement Transmitted to Council on Environmental Quality on February 13, 1976.

USDA SOIL CONSERVATION SERVICE

FINAL ENVIRONMENTAL IMPACT STATEMENT [1/]

for

Hall-Flat Creek Watershed, Indiana

AUTHORITY

Installation of this project constitutes an administrative action. Federal assistance will be provided under authority of Public Law 83-566, 83d Congress, 68 Stat. 666 as amended.

SPONSORING LOCAL ORGANIZATIONS

Dubois County Soil and Water Conservation District and the Hall-Flat Creek Conservancy District (Sponsors).

PROJECT PURPOSES AND GOALS

Watershed Protection

One goal of the project Sponsors and the Soil Conservation Service (Service) is to reduce the recognized problem of excessive erosion on watershed land. Soil losses can be reduced in two ways: (1) by voluntary changes in the use of seriously eroding land to some use that would protect the soil resource; and (2) by applying vegetative and structural measures on eroding land to protect the soil resource without significantly changing the land use. These two basic principles can be applied to seriously eroding cropland, pastureland, forest land, and land in other uses to effectively reduce erosion to a tolerable level.

It was recognized that the application of soil conservation measures would satisfy several objectives of the Sponsors, the Service, and the public in general. Conservation practices applied to cropland, pastureland, and forest land would facilitate the efficient production of agricultural products with minimal depletion of the soil resource and the economy would be stimulated. Wildlife would benefit from special wildlife plantings and vegetative measures used to retard erosion. The quality of water in the watershed streams for fish, wildlife, and human use would be improved as a result of reduced sedimentation. In summary, the goal of reduced watershed erosion was set because it would allow watershed residents to fully utilize their soil resource and at the same time improve the quality of the environment.

Flood Prevention

The overall objective of the Sponsors is to develop a comprehensive resource plan which will lead toward the full utilization of land and water resources within the watershed area. The Sponsors desire to develop the natural

1/ All information and data, except as otherwise noted by reference to source, were collected during watershed planning investigation by the Soil Conservation Service, U.S. Department of Agriculture.

resources of the watershed to the fullest extent consistent with providing the greatest economic return to the residents. At the same time there is a strong desire to preserve the future usefulness of the watershed's resources.

The Sponsors desire to reduce floodwater damage within the watershed the maximum amount economically feasible. This will help protect the natural resources of the watershed and reduce damage to roads, bridges, machinery, fences, drainage ditches, power lines, etc.

Drainage

Another project goal is agricultural drainage. The Sponsors believe this goal will be achieved without project action when flooding is reduced. Landowners could then voluntarily install surface and/or subsurface drainage systems that would provide a level of soil drainage consistent with optimum management efficiency for growing row crop-small grain rotations. Fulfillment of the drainage goal will not reduce the acreage of any type 3, 6^{3}, or 7 wetlands 1/ within the watershed.

Fish and Wildlife

Another project goal is to establish and improve wildlife habitat while minimizing habitat losses resulting from project installation. Vegetative watershed protection measures are planned to include species of plants that provide cover and food for a variety of animals and birds. Plantings intended solely for wildlife use were also included. Less intensive use of erosion prone land is recognized as being a benefit to wildlife as well as a soil conservation measure. The Sponsors feel that sediment reductions in watershed streams as a result of watershed protection and flood prevention measures will improve the watershed stream fishery. The establishment of lakes and farm ponds will create a lake type fishery and provide a constant water supply for wildlife in areas surrounding these structures. Vegetative measures, land changes, and special design features associated with watershed lakes are planned as mitigation for wildlife habitat destroyed by project installation. In summary, the goal of the Sponsors and the Service is to create a better environment for fish and wildlife within the watershed.

PLANNED PROJECT

Land Treatment Measures

Conservation land treatment practices and measures installed and those to be installed during the project installation period will adequately treat 37,480 acres of the 43,107 acres of the project area. This land treatment will be voluntarily applied by landowners throughout the entire watershed and will supplement the ongoing land treatment program.

1/ U.S. Department of Agriculture, Soil Conservation Service. Limiting Techincal Assistance for Drainage. Inter-Agency Programs Memorandum-8, Indiana Supplement 1, Indianapolis, Indiana, March, 1966 (Memo 8 contains U.S. Department of the Interior, Fish and Wildlife Service Circular 39 - Wetlands of the United States).

Total land treatment practices and measures will adequately treat an additional 18,025 acres during the project installation period. Approximately 5,500 acres of this total are cropland, 5,800 acres pastureland, 5,350 acres forest land, and 1,375 acres land in other uses. The following is a listing with definitions of land treatment measures to be applied respectively to cropland, pastureland, and forest land. 1/

Land Treatment Measures to be Applied to Cropland

1. Contour Farming: Farming sloping cultivated land in such a way that plowing, preparing land, planting, and cultivating are done on the contour. (This includes following established grades of terraces, diversions, or contour strips.)

2. Grade Stabilization Structure: A structure to stabilize the grade or to control head cutting in natural or artificial channels. (Does not include structures used in drainage and irrigation systems primarily for water control.)

3. Subsurface Drain: A conduit, such as tile, pipe, or tubing, installed beneath the ground surface and which collects and/or conveys drainage water.

4. Drainage Field Ditch: A graded ditch for collecting excess water within a field.

5. Diversion: A channel with a supporting ridge on the lower side constructed across the slope.

6. Grassed Waterway or Outlet: A natural or constructed waterway or outlet shaped or graded and established in vegetation suitable to safely dispose of runoff from a field, diversion, terrace, or other structure.

7. Terrace: An earth embankment or a ridge and channel constructed across the slope at a suitable spacing designed to prevent soil erosion.

8. Conservation Cropping System: Growing crops in combination with needed cultural and management measures. Cropping systems include rotations that contain grasses and legumes as well as rotations in which the desired benefits are achieved without the use of such crops.

Land Treatment Measures to be Applied to Pastureland

1. Pasture and Hayland Management: Proper treatment and use of pastureland or hayland.

2. Pasture and Hayland Planting: Establishing and reestablishing long-term

1/ U.S. Department of Agriculture. Soil Conservation Service. Timekeeping and Progress System Codes. Fieldbook. Government Printing Office. July 1, 1973.

stands of adapted species of pereinnial, biennial, or reseeding forage plants. (Includes Pasture and Hayland Renovation. Does not include Grassed Waterways or Outlet on cropland.)

3. Pond: Water impoundment made by constructing a dam or embankment or by excavating a pit or "dugout".

4. Spring Development: Improving springs and seeps by excavating, cleaning, capping, or providing collection and storage facilities.

Land Treatment Measures to be Applied to Forest Land

A land treatment program has been developed for private forest lands from a statement of land treatment needs prepared by the Indiana Department of Natural Resources (IDNR), Division of Forestry in cooperation with the U.S. Forest Service (USFS) and includes the following measures:

1. Forest Land Management Plans: To provide for the proper installation and maintenance of forestry measures on private forest land.

2. Tree Planting: To adjust planned land use with capability and reduce runoff and erosion by developing a protective cover and an absorbent forest floor of litter and humus.

3. Hydrologic Stand Improvement Measures: To improve the hydrologic condition of private forest stands by manipulation of stand composition to create favorable conditions for the maximum production and protection of litter, humus, and forest cover. They include thinnings, weedings, improvement, salvage, intermediate harvest and harvest cuttings, supplemental plantings, and protection from overgrazing by domestic livestock.

During development of resource conservation plans, landowners will be encouraged to plan and apply forest management practices that are important in developing and maintaining favorable wildlife habitat conditions.

Nonstructural Measures

Present flood plain land use is agricultural cropland, forest land, and pastureland. The only structures presently in the flood plain are roads, bridges, and utilities. Agricultural use of a flood plain is compatible with a flood plain management plan that minimizes damage and loss of life. Flood protection provided by this plan is not sufficient for other more intensive flood plain uses. Therefore, the flood plain is expected to remain in agricultural uses indefinitely. The county governments have the authority to implement zoning ordinances if needed to prevent non-agricultural uses in the future.

Structural Measures

Structure measures planned are 22 single purpose floodwater retarding reservoirs. Sediment pools range in size from 3.7 acres to 24.1 acres, an average of 10.4 acres. Floodwater pools range in size from 10.1 acres to 65.8 acres, an average of 25.1 acres. An average 61 acre-foot of sediment will accumulate in the sediment pools of each structure over the 100 year

life of the project. An average of 209 acre-feet of floodwater will be temporarily stored to the crest of the emergency spillway of each structure.

Sediment pool depths at the dams will range from 4.0 feet to 19.5 feet, an average of 11.0 feet. However, since sediment pools are the primary borrow source, the final average depth of each structure will be somewhat greater. The initial volume of water contained in the sediment pools will be displaced by sediment over the 100-year design life of the structures.

Foundation conditions at the 22 structure sites range from shallow (6-8 feet) alluvium to deep (+30 feet) alluvium and colluvium. These alluvial deposits can be removed and backfilled with a tight, well compacted soil as necessary, to assure structural safety and minimal inlet and pipe settlement.

The principal spillways on all structures will consist of reinforced concrete inlets with reinforced concrete pipe outlets. Outlets are provided on all structures to allow drawdown of the sediment pools.

All structures will have two stage inlets, storing one inch of flood runoff between the high and low stages. This is the runoff expected from one to two-year frequency storms.

Eight of the reservoirs are designed to store the runoff from a four percent chance flood. Based on long term records, this flood will occur once in 25 years (25 year flood). Three of the reservoirs will store the runoff from a 10 percent chance flood (10 year flood). The remaining 11 reservoirs will provide storage in excess of the minimum required 10-year frequency. This storage approaches the 25-year frequency amount for the majority of these 11 structures.

All dams will be constructed of earth fill. Emergency spillways will be excavated in soil and seeded to erosion resistant vegetation.

Clearing of the sites will be limited to that area necessary for construction of the dams and emergency spillways and the borrow areas. It is estimated that this clearing will amount to 22 acres for the dams and spillways and 46 acres for borrow. Landowners will be encouraged to remove all merchantable timber prior to construction.

Primary borrow sources for fill material will be within the land rights areas needed for dams, emergency spillways, and reservoir sediment and flood pools. If these sources should be inadequate, additional borrow sources will be obtained in upland areas or from the downstream flood plain.

All structures are designed with an expected life of 100 years. Low stage floodwater inlets for the structures are set at the 100 year submerged sediment pool elevations. Approximately 90 percent of the total sediment accumulation will be submerged.

Installation and subsequent operation and maintenance of all structural measures will be in accordance with state and local public health and safety regulations.

The following table lists approximate acres of land rights required and the present land use:

	Cropland	Pastureland	Forest Land	Total
Sediment Pool	123	52	54	229
Flood Pool	138	64	121	323
Flowage	5	3	5	13
Dams and Emergency Spillway	18	14	22	54
TOTAL	284	133	202	619

A county gravel road will be constructed across the top of the dam on structure No. 32. Structure No. 40 will require the abandoning of 3,000 feet of county gravel road. Approximately 1,000 feet of private road will be constructed around structure No. 43. Structure No. 62 will require that 2,500 feet of county gravel road be constructed around it. Structure No. 79 will involve the construction of 1,200 feet of private road for access purposes and the abandoning of 2,000 feet of county road. Also at site No. 79, a levee will be constructed downstream of the right abutment to protect a house from the effects of a possible structure failure. The unimproved county right-of-way crossing the pool area of structure No. 78 will be abandoned. Floodwaters from very large storms at structure No. 64 will back through the bridge opening under Highway 164 but will not flood the highway.

One mobile home, located downstream of structure No. 26, will require relocation. It is estimated that three people will be involved in the relocation. During the construction period uniform relocation assistance will be provided to any other eligible persons.

Sediment pools of the structures will have potential for limited recreational use by owners, operators, and their friends by permission. Access by the general public will be prohibited unless or until adequate sanitary facilities are provided which meet state and local health requirements. Sponsors have indicated they will provide public access to some of the pools if they can obtain sufficient easements without significant increase in costs. In the event that easements can be obtained and required sanitary facilities installed, the State of Indiana has indicated they will provide fish for stocking the pools, and construction of a roadway, parking lot, and boat launching ramp at each site.

All dam and emergency spillway areas and those borrow areas outside of sediment pools will be seeded immediately following construction with a mixture of grass, legumes and/or low growing woody species conducive to wildlife use and for the protection of the structural features. Sufficient soil material will be left in borrow areas outside of sediment pools for the establishment of such vegetation. Borrow materials will not be removed from any area which may endanger structure stability. Timber from cleared areas will be disposed of by anchoring in the sediment pool area to provide fishery habitat and stacking on shore for wildlife habitat. Landowners will be encouraged to sell and/or utilize all merchantable material. All other construction activities will be conducted

in such a manner as to minimize onsite erosion and sediment production. Sediment traps will be constructed below erosive areas to catch construction related sediment.

Dam, emergency spillway, and sediment pool areas of all structures subject to livestock grazing activities will be fenced to exclude livestock.

An archeological and historical reconnaissance conducted by a professional archeologist located four archeological sites. None were considered significant enough to warrant preservation or recovery.

In accordance with PL-93-291, any evidence of other archeological sites uncovered during construction will be reported to the National Park Service and the State Historic Preservation Officer. Since this is a federally assisted local project, there will be no change in the existing responsibilities of any federal agency under Executive Order 11593 with respect to archeological and historical resources.

Operation and Maintenance

Works of improvement are planned, designed, and installed to serve certain purposes. The total benefits to be derived from the installation cannot usually be realized unless the installation is operated and maintained in such a manner that it will serve the purpose, both as to function and time, for which it was installed. An active program for operation and maintenance consists of:

(1) an agreed-to plan which provides adequate and sound arrangements for proper operation, timely inspection, prompt and appropriate performance of needed maintenance, financing the costs of operation and maintenance, and the maintaining of records reflecting the actions required and taken, and

(2) the carrying out of the provisions of the agreed-to plan in a manner consistent with the spirit, intent, and purpose of the plan and the project.

The Hall-Flat Creek Conservancy District (District) is responsible for the proper operation and maintenance without cost the the Service for the structural measures installed in whole or in part with PL-566 funds and for which there will be a continuing need for operation and maintenance.

The Service is responsible for (1) determining that sound arrangements have been made to assure that all structural measures installed, in whole or in part, with PL-566 funds will be operated and maintained in such a manner as to serve the purpose for which they were installed, (2) determining that sound financial arrangements have been made by the District to defray the costs of operation and maintenance, (3) making appropriate inspection to assure that the structural measures are operated and maintained properly and that all maintenance indicated by inspection reports is performed, (4) promptly calling attention of the District any failure on its part to properly operate and maintain the structural measures as provided in the operation and maintenance agreement, and (5) providing such technical

services as required for proper operation and the preparation of plans, designs, and specifications for needed maintenance of the structural measures.

All structures are designed for automatic discharge of floodwater. Average annual operation and maintenance cost for the floodwater retarding reservoirs is $6,950.

Normal operation and maintenance work will consist of such items as (1) repairing damage to structural embankments and spillways, (2) removing trash from the sediment pools and principal spillways, and (3) liming and fertilizing vegetative cover to maintain effective stands.

Major repair may involve such things as (1) repairing separated joints, and cracks or breaks in the principal spillway, (2) correcting seepage, (3) replacing significant backfill around structures resulting from major erosion damage, (4) major revegetation due to failure to obtain an adequate vegetative cover, and (5) restoring areas with significant erosion caused by unusual flow (volume, recurrence or extended period of time) in emergency spillways.

An establishment period will follow each structural measure installed. The term "establishment period" applies only to vegetation installed as a structural measure or associated with more complicated structural measures. The establishment period terminates when the Service notifies the District that vegetative cover is established or after two growing seasons have elapsed since the initial installation of the vegetative measure, whichever occurs first. During the establishment period, the state conservationist may approve PL-566 cost sharing for additional work that is required to obtain adequate vegetative cover. However, this work must be done on the same land area that was originally vegetated. This includes the installation of measures such as small erosion control structures, diversions, or tile lines needed to assure the establishment of vegetated cover. Work needed on vegetative measures after termination of the establishment period is considered as maintenance and is the responsibility of the District. At no time can the Service assume this responsibility.

The District and Service will jointly inspect each structural measure at least annually and after unusually severe floods or after the occurrence of any other unusual conditions that might adversely affect the structural measure. These joint inspections will continue for a three year period ending at midnight on the third anniversary of the date on which the structural measure was accepted. The District will be encouraged to invite representatives of IDNR and the Department of the Interior, U.S. Fish and Wildlife Service (USF&WS) to participate in this inspection. An inspection report will be jointly prepared by the members of the inspection team. A copy will be furnished to each organization or agency participating in the inspection. Follow-up reports will be prepared at regular intervals until all deficiencies noted in the inspection report have been satisfactorily corrected.

After the three-year period, the structural measures will be inspected annually and after unusually severe floods by the District. An inspection report will be prepared by the District and a copy furnished to the Service.

As the structural measures are constructed, operation and maintenance funds will be collected. When the project is completed a cumulative fund will be available, equal to or greater than the estimated annual operation and maintenance cost. An operation and maintenance budget will be developed each year to take care of current needs and to maintain the reserve fund.

Operation and maintenance activities will be set forth in the operation and maintenance plan and carried out in a manner to minimize adverse environmental effects. The Service's Indiana Watershed Operation and Maintenance Handbook will be used as a basis for the operation and maintenance plan. The operation and maintenance plan will supplement the operation and maintenance agreement executed between the Service and the District, prior to signing a project agreement.

A fish and wildlife management section will be incorporated in the operation and maintenance plan. This section will be developed by an interdisciplinary team consisting of the following organizations and agencies: the Dubois County Soil and Water Conservations District (SWCD), the District, IDNR, USF&WS, and the Service.

Mitigation features, such as the fences for livestock exclusion, will be maintained by the District and repaired and replaced when required.

The operation and maintenance agreement will include specific provisions for retention and disposal of property acquired or improved with PL-566 financial assistance.

Project Costs

Total project installation costs are estimated at $2,912,127 of which PL-566 funds are $2,170,790 and Other funds are $741,337. Estimated construction cost of the structural measures is $1,585,060, which is 100 percent PL-566 funds.

ENVIRONMENTAL SETTING

Physical Resources

The Hall-Flat Creek Watershed occupies an area of 43,107 acres (67.35 square miles) in Dubois County in southwestern Indiana. Located within this watershed are the villages of Celestine, Saint Anthony, Saint Marks, and Schnellville. The city of Jasper is located about one mile from the western boundary of the watershed. Larger nearby metropolitan areas include Indianapolis, 125 miles northwest, and Louisville, Kentucky, 70 miles east.

The watershed is situated in the southern part of the White-Patoka Subregion of the Ohio Region as classified by the United States Water Resources Council. 1/ This subregion includes the main part of southern and central Indiana.

The watershed land use is approximately one-third cropland, one-third pastureland, and one-third forest land and miscellaneous land including roads, farmsteads, and urban.

The flood plain is approximately 75 percent cropland, 2 percent pasture-land, and 23 percent forest land. The forest land is primarily located in the flood plain of Straight River where impaired drainage along with flooding precludes the use of the land for cropland.

Flood plain scour is the only significant form of erosion damage on the flood plain. This affects 381 acres.

Erosion in excess of tolerable limits occurs in the sloping upland cropland areas.

The watershed is located in the unglaciated portion of the Crawford Upland Physiographic Province. The Crawford Upland is a maturely dissected plateau with narrow, flat-topped drainage divides. Elevations range from about 450 feet above sea level near the junction of Hall and Flat Creeks to about 760 feet at the eastern margin of the watershed.

The watershed is characterized by abundant stream valleys and a well-integrated, dendritic drainage system. Both Hall Creek and Flat Creek originate in the eastern upland portion of the watershed. The upper reach of Hall Creek flows northwest to Schnellville and has no appreciable flood plain development. Below Schnellville, the flood plain is about one-eighth of a mile wide and broadens to about a half-mile where Grassy Fork joins. Flat Creek flows west to Saint Marks, then flows northwest to join Hall Creek at the Straight River, one-quarter mile east of Indiana Route 162. Straight River flows about 2 miles west to the Patoka River, a major tributary of the Wasbash River. The upper limit of the flood plain of Flat Creek is about 2 miles east of Kyana. The flood plain is approximately 500 feet wide at Kyana and broadens to about 1,200 feet near Saint Marks. Near Maltersville the flood plain is a half mile wide. Most of the Hall and Flat Creeks have been modified. There are 55.4 miles of perennial

1/ Water Resources Council Water Resources Regions and Subregions for the National Assessment of Water and Related Land Resources. Washington, D.C.: Government Printing Office, July 1970.

streams (streams that flow at all times of the year, except during extreme drought) in the watershed. Perennial streams include the trunks of Hall and Flat Creeks, Straight River, and Grassy Fork, and the middle and lower reaches of all named major tributaries. There are 93.5 miles of intermittent streams (streams with continuous flow through some seasons of the year but little or no flow during other seasons). Intermittent streams include the upper reaches of named tributaries to Hall and Flat Creeks, Grassy Fork, and the major tributaries which flow across definable flood plains. Many ephemeral streams (streams which flos only during periods of surface runoff) occur in the well defined, steep narrow drainageways tributary to intermittent streams. The great density of ephemeral streams precludes accurate determination of their total length.

Other surface water areas include numerous farm ponds and small reservoirs, most of which are man-made. Four small lakes, having permanent pools between 5 and 25 acres are presently located within the watershed (see Watershed Project Map). Lakes numbered 50 and 53 are owned by local conservation clubs and are used for recreation, fish, and wildlife purposes for club members and their families. Lakes numbered 51 and 52 are privately owned fishing and recreation lakes. Each of the structures has some incidental flood prevention benefit.

The water quality of the watershed was assessed by the U.S. Geological Survey. The study indicates that

> "Water quality in the Hall-Flat Creek Watershed was good. However, water quality problems could arise from fertilizer and insecticide applications to cropland.
>
> "Calcium and sulfate were the dominate ions in the streams of the study area and the level of mineralization was relatively low for Indiana (dissolved solids of 76 to 130 mg/l). Concentrations of dissolved iron in the streams were below problem-causing levels, but dissolved manganese exceeded problem-causing levels at most of the sites sampled.
>
> "Nutrient concentrations (nitrogen, phosphorus, and organic carbon) in streamwaters were normal for the area and time of year. Streamwaters contained between 0.57 and 1.3 mg/l nitrate (as N). These values are sufficient to cause enrichment and undesirable biologic growth, but are not significant with respect to public use. Nutrient concentrations for streamflow conditions other than sampled in this survey could not be adequately predicted from these data. However, nitrate concentrations in the Hall-Flat Creek Watershed probably are related directly to streamflow and time of year, with high concentrations being associated with winter and spring flows and lowest concentrations with summer and fall low flows. Streamwater nitrate concentrations also appear to be related to the level of agricultural use, with highest concentrations being associated with forested areas.
>
> "Fecal coliform bacteria concentrations in the April samples ranged from 20 to 360 colonies per 100 milliliters and fecal streptococci bacteria from 5 to 8,800 colonies per 100 milliliters. Fecal bacteria concentrations were significant only at one site sampled and

indicated an animal waste source of bacteria.

"Bed materials in the Hall Creek site contained dieldrin, DDD, and DDE, whereas, the Flat Creek and Straight River sites contained aldrin, dieldrin, heptachlor epoxide, DDD, and DDE. Concentrations found were small, (1.7 micrograms per kilogram or less) but are important as an indication that insecticides are entering the waterways, and so have the potential for accumulating in local biological food chains.

"Well-balanced benthic communities were found at both the Hall and Flat Creek sites (diversity indices 3.3 or more). Also, the biomasses found in these sites and the relative abundance of good indicator organisms suggest the presence of good environmental conditions for the benthic communities. A qualitative reconnaissance of Straight River suggests that a good diversity of organisms was present but because of the shifting sand bottom the numbers per unit area of channel bottom were small." 1/

Most of the watershed is underlain by the Mansfield Formation of early Pennsylvanian age. The Mansfield Formation is 60 percent varicolored, cross-bedded, coarse-grained sandstone, 38 percent shales and siltstones, and 2 percent limestone, chert, and coal. West of Schnellville Conservation Lake, the bottom lands of Hall Creek are underlain by sandstones and shales of late Mississippian age.

Surficial materials are mainly thin loess and residual soils in the uplands and Quarternary glacial lake clays and Recent alluvium in the lowlands.

Oil and gas wells have been drilled within the watershed to depths of 400 to 1,200 feet. Nearly all are dry holes. Oil and gas, however, are produced in other areas to the west and south of the watershed. 2/

Coal has been mined in the past, although no commercial mines are operating at present. 3/ The coal reserves are either too thin or too low in quality for profitable mining and therefore will not affect the structural integrity of proposed project measures.

Sandstone has been quarried for domestic building, but low quality limits its potential as a marketable product.

1/ Ayers, Mark A., 1975, A Water Quality Assessment of the Hall-Flat Creek Watershed, Dubois County, Indiana: Open-File Report, USDI, Geological Survey, Indianapolis, Indiana.

2/ Carpenter, G. G. and Keller, Stanley J., Oil Development and Production in Indiana During 1969. Indiana Department of Natural Resources, Geological Survey. Bloomington, Indiana, 1969.

3/ Indiana Department of Natural Resources, Geological Survey. "Distribution, Structure, and Mined Areas of Coals in Dubois County, Indiana", 1964.

Ground water supplies are limited throughout the watershed. Bedrock aquifers are mainly relatively dense sandstones of low to moderate permeability. Minor supplies of low quality ground water are tapped from flood plain alluvium in the low reaches of the watershed. Ground water supplies must generally be supplemented by surface water supplies.

There are three soil associations in the watershed. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil. The soils in one association may occur in another, but in a different pattern. Each soil association that occurs in the watershed is described below.

Wellston-Zanesville-Berks association is characterized by deep, and moderately deep, well drained and moderately well drained, medium textured, gently sloping to steep soils on uplands.

This association is on the uplands of the watershed and makes up 83 percent of the total area. About 27 percent of the association is Wellston soils, 26 percent is Zanesville soils and 14 percent is Berks soils. Among the less extensive soils are the Johnsburg, Gilpin and Tilsit soils.

Wellston soils are deep, strongly sloping to steep and well drained. They formed in about 24 inches of loess and material weathered from sandstone and shale bedrock. Their surface layer typically is brown silt loam about 6 inches thick. The subsoil is about 28 inches thick. The upper 14 inches is yellowish brown and strong brown silt loam and light silty clay loam and the lower 14 inches is yellowish brown firm silty clay loam. The underlying material is yellowish brown and pale brown heavy silt loam. Sandstone and shale are at a depth of about 42 inches.

Zanesville soils are deep, gently sloping to strongly sloping and well drained and moderately well drained. They formed in about 30 inches of loess and material weathered from sandstone and shale bedrock. Their surface layer is brown silt loam 7 inches thick. The upper 21 inches of the subsoil is strong brown, friable, heavy silt loam and the lower 11 inches is yellowish brown, firm heavy silt loam fragipan. Below this to a depth of 60 inches the substratum is yellowish brown sandy clay loam. Sandstone and shale bedrock is below a depth of 60 inches.

Berks soils are moderately deep, strongly sloping and steep and well drained. They formed in material weathered from sandstone and shale bedrock on uplands. Their surface layer typically is very dark gray channery silt loam about 2 inches thick. The subsurface layer is light yellowish brown channery silt loam about 5 inches thick. The subsoil is yellowish brown, friable channery silt loam about 15 inches thick. The underlying material is yellowish brown and light yellowish brown channery silt loam. Bedded, fractured siltstone and sandstone are at depths of about 30 inches.

The gently sloping and moderately sloping soils in this association are

used for farming. Erosion and runoff are hazards. A limited root zone restricts the use of the soils that are moderately deep or have a fragipan. The strongly sloping to steep soils are in permanent pasture or woodland. Non-farm uses of these soils are limited. Slopes greater than 15 percent impose severe ratings for many uses. The fragipan in the Zanesville soil has moderately slow to slow permeability, which severely limits its use.

Stendal-Steff-Cuba association is characterized by deep, somewhat poorly drained, to well drained, medium textured nearly level soils on bottom lands. This association is on the bottom lands of the larger streams throughout the watershed and make up 15 percent of the area. About 39 percent is Stendal soils, 9 percent is Steff soils, and 9 percent is Cuba soils. The remaining 43 percent consists of less extensive soils, including Pekin, Burnside, Bartle, and Bonnie soils.

Stendal soils are nearly level and somewhat poorly drained. They formed in strongly acid or very strongly acid alluvium on bottom lands. Their surface layer typically is grayish brown silt loam about 7 inches thick. The subsoil is mottled grayish brown and brown, friable silt loam about 24 inches thick. The underlying material to a depth of 60 inches is mottled gray, silt loam stratified with thin layers of fine sand.

Steff soils are nearly level and moderately well drained. They formed in strongly acid or very strongly acid alluvium on bottom lands. Their surface layer typically is brown silt about 7 inches thick. The upper 16 inches of the subsoil is brown, friable silt loam and the lower 25 inches is light brownish gray, friable silt loam. The underlying material to a depth of 60 inches is light brownish gray silt loam.

Cuba soils are deep nearly level and well drained. They formed in strongly acid or very strongly acid alluvium on bottom lands.

Their surface layer typically is dark grayish brown, silt loam about 9 inches thick. The subsoil is yellowish brown, friable silt loam about 18 inches thick. The underlying material from 27 to 33 inches is yellowish brown and brown silt loam and below this to a depth of 60 inches is yellowish brown and grayish brown stratified loam and silt loam that contain thin lenses of sand.

The soils in this association are used for farming. Flooding is the major hazard in use and management. Wetness is also a problem on Stendal soils and adequate drainage is needed. Steff soils have a water table at 3 to 6 feet and drainage is usually not needed. Protection from flooding is needed if prolonged high yields are to be maintained on these soils. Only a small amount of this association is used for pasture. Non-farm uses are severely limited becasue of flooding.

Wetness may be a problem on Steff soils for some uses.

Peoga-Bartle association is characterized by deep, poorly drained and somewhat poorly drained, medium textured, nearly level and gently sloping soils on glacial lake plains or terraces.

This association is on low alluvial terraces or broad glacial lake plains in the western edge of the watershed. Only 2 percent of the total area is in this association. About 36 percent is Peoga soils and 30 percent is Bartle soils. The remaining 34 percent is less extensive soils, including Zanesville, Stendal, Steff, and Pekin soils.

Peoga soils are deep, nearly level and poorly drained. They formed in loess over weathered lakebed material. Their surface layer typically is mottled gray silt loam about 10 inches thick. The subsurface layer is mottled gray, silt loam about 5 inches thick. The subsoil is 40 inches thick. The upper 8 inches is mottled gray, friable silt loam and the lower 32 inches is mottled gray, firm silty clay loam. The underlying material to a depth of 90 inches is mottled gray, silty clay stratified with silt loam.

Bartle soils are deep, nearly level and gently sloping and somewhat poorly drained. They formed in silty materials of mixed origin which have a thin loess capping. At lower depths there may be stratified glacial lakebed materials. The surface layer of Bartle soils typically is grayish brown silt loam about 10 inches thick. The subsurface layer is mottled gray and yellowish brown silt loam about 10 inches thick. The subsoil is 50 inches thick. In sequence from the top, the upper 5 inches is mottled gray and heavy silt loam; the next 14 inches is mottled gray, firm brittle silt loam fragipan; and the lower 31 inches is mottled gray firm silty clay loam. The underlying material to a depth of 100 inches is mottled gray stratified silty clay loam, silty clay and silt loam.

The soils in this association are used for farming. Wetness is the main limitation in use and management. When adequately drained these soils are suited to most crops commonly grown in the county. Bartle soils also have a fragipan at an average depth of about 30 inches and this restricts the rooting zone of plants. Non-farm uses of this association are limited. Wetness and the slowly permeable subsoils severely limit their use.

Mean temperatures in the vicinity range from 35 degrees Fahrenheit in January to 74 degrees in July. Recorded extremes range from minus 20 degrees to 108 degrees above zero. The mean annual temperature is 57 degress; mean annual precipitation is 47.4 inches. The average date of the last spring freeze is April 22 and that of the first fall freeze is October 17. The average frost-free season is 179 days. 1/ 2/

Present and Projected Population

Census data for 1960 and 1970 list the population of Dubois County as 27,463 and 30,934 respectively. 3/ This is a 12.6 percent increase during the 10 year period. Hall-Flat Creek Watershed comprises almost 16 percent of the land area of Dubois County. About 10 percent of the county population resides

1/ U.S. Department of Commerce. Weather Bureau. "Climates of the United States, Indiana. Climatography of the United States No. 60-12 Washington, D.C.: Government Printing Office, 1964.

2/ U.S. Department of Commerce. Weather Bureau. "Indiana". Climatic Summary of the United States-Supplement for 1931 through 1952. Washington, D.C.: Government Printing Office.

3/ U.S. Department of Commerce. Bureau of the Census. 1970 Census of Population, General Population Characteristics, "Indiana". Washington, D.C.: Government Printing Office.

within the watershed. New home construction in the watershed area indicates a higher population growth rate for other unincorporated areas of the county. Construction of new homes and businesses and continued expansion of wood using industries in nearby Jasper are indicative of an expanding economy. Median age of the population of Dubois county is 25.0 years compared to 27.2 for Indiana. The population growth is expected to continue at approximately the same rate for the next decade.

The population of Dubois County and Hall-Flat Creek Watershed is predominately of German descent. There are 55 minority persons in Dubois County. None are believed to reside in Hall-Flat Creek Watershed.

Almost seven percent of the families in Dubois County are low income according to the 1970 census. Family income in the watershed area is expected to be somewhat above county average.

Economic Resources

The agricultural econmony of Hall-Flat Creek Watershed is based on farm enterprises emphasizing the production of livestock and poultry products. A poultry dressing plant, an egg processing plant, and a hatchery are located in nearby Jasper. Another poultry dressing plant is located in Huntingburg, four miles to the southwest. These provide good close markets for poultry and poultry products. Hogs and cattle are either sold at the local market or trucked to Evansville (50 miles southwest) or Louisville (70 miles east). Grain grown in the watershed is fed on the farms and additional grain is imported primarily from the Wabash, White, and Ohio River bottom lands to the west and south. According to the census, livestock and poultry products account for over 90 percent of all farm sales in Dubois County.

The principal grain grown in the watershed is corn. Corn accounts for over 85 percent of the cultivated crops grown. The grain produced on the flood plain and small, rolling upland fields is fed to livestock and poultry. Soybeans and wheat are grown on the remainder of the cultivated land. Steeper upland fields are either wooded or seeded to hay and pasture.

Crop yields in the watershed have been increasing rapidly. Improved management, including drainage, increased fertilizer application, increased agricultural chemical usage, and use of improved seeds account for much of the increase. Corn yields are now approximately 100 bushels per acre. Soybeans and wheat yield about 35 bushels per acre.

Land well suited to grain crops is scarce in Hall-Flat Creek Watershed and most of Dubois County. The farms of the area support large poultry and livestock enterprises. Grain grown in the watershed is fed on the farm where it is grown and large quantities are imported from grain surplus areas in the river bottoms to the west and south. Severe floods in the Hall-Flat Creek valley disrupt the poultry and livestock feeding programs by greatly reducing the amount of locally grown grain. Large quantities of feed must be imported during these years to maintain the poultry and livestock enterprises.

The land in Hall-Flat Creek Watershed is mostly privately owned. The Ferdinand State Forest contains 600 acres of land along the southeast perimeter of the watershed. There are 310 farms wholly or partially within the watershed. Average size of Dubois County farms in 1969 was 182 acres

with an average value of $52,000. Land prices have risen very rapidly since 1969. Census figures show 41 percent of the farms reported sales under $5,000 while 16 percent had sales exceeding $40,000 per year in 1969.

The Southern Railroad main line from St. Louis, Missouri, to Louisville, Kentucky and State Road 64 parallel each other across the south side of the watershed. State Road 162 crosses the western portion and 164 follows along the northern edge of the watershed. Interstate Highway 64 from St. Louis to Louisville is about 15 miles to the south. Improved county roads provide access to all parts of the watershed.

Jasper (population 8,641) is on the northwestern watershed boundary; Huntingburg (population 4,800) is approximately 3 miles west of the watershed. The communities of Celestine, Schnellville, Saint Marks and Saint Anthony are located within the watershed.

The watershed land use is approximately one-third cropland, one-third pastureland, and one-third forest land and miscellaneous land. Jasper is known as the "wood office furniture capital of the nation". Eight furniture plants are located in the city and others are scattered throughout the county. Lumbering and processing of wood products are important items of Dubois County's economy. Local markets for quality saw logs, veneer logs, stave material, pallet material, and pulpwood are good.

Forest product sales account for less than one percent of the farm product sales, crop sales 9 percent, and livestock sales over 90 percent. Over 41 percent of the work force is employed in manufacturing. Factories are mostly wood using industries which produce fine wood furniture. Over 90 percent of the work force are employed within the county.

Plant and Animal Resources

Both Beech-Maple and Oak-Hickory climax species exist in the watershed with Oak-Hickory predominating. Other prominant species of hardwoods include yellow poplar, ash, black walnut, and sycamore. Various stages of succession exist in the area, however, most forest land is in the later stages.

Important crop species include corn, soybeans, wheat, and other small grains. Pastureland consists of native and adapted species of grasses and legumes. Important grasses include tall fescue, bromegrass, orchardgrass, and bluegrass. Legumes found are alfalfa, clover, and lespedeza.

According to a 1968 fish and wildlife report,1/ the watershed streams support a low quality, lightly utilized, warm-water fishery. Limited angling occurs during the spring for sucker, catfish and small-mouth bass. Low stream flow during the summer inhibits a high quality stream fishery.

The diversified and interspersed land use pattern provides adequate food and cover for a variety of wildlife species. (see Appendix C)

1/ Preliminary Report of the fish and wildlife aspects of Hall-Flat Creek Watershed Project. Bureau of Sport Fisheries and Wildlife. July 1968.

Rabbit populations are good in the western and southwestern watershed areas. Deer and quail populations are high in the southern portion of the watershed, while squirrel are common over most of the area.

Squirrel and rabbit hunting comprise more than half of the preferred watershed hunting. Quail hunting and night hunting for raccoon and other furbearers account for about 25 percent of the total hunting. Southcentral Indiana, of which the project area is a part, usually maintains the lowest annual waterfowl harvest of any major geographical area in the state.

Recreational Resources

The low quality of sport fishery is not enticing to anglers. Private ownership limits access to the streams.

Nearby public recreational facilities include the 200 acre Beaver Lake to the north. This lake is heavily used for boating, swimming, and picnicking.

The County Recreation Park, with a two-acre lake, is the only general public recreation facility in the watershed. The park is used for picnicking and fishing.

The Ferdinand State Forest lies a few miles southeast of the watershed. It has a 40-acre lake and an adjoining recreation facility operated and maintained by the Indiana Department of Natural Resources, Division of Forestry.

Facilities are provided at this location for camping, swimming, picnicking, hiking, boating, fishing, and hunting. The design capacity of the recreational facility is 600 people. This facility is fully utilized during the 14-week summer recreation season. Estimates are that 25,000 to 30,000 people use the facility each year. Other public recreational resources in the watershed includes state and forest land which is available for hiking, nature observation, and hunting.

The Anderson River Watershed, which joins to the east, has a recreation plan which will provide an estimated 175,125 recreation visits annually.

Patoka Lake, a reservoir of over 8,000 acres, is currently under construction by the U.S. Army Corps of Engineers. About 7,000 acres of land adjacent to the lake will be acquired for outdoor recreational use. This lake is located a few miles northeast of the watershed.

Recreation potential within the watershed is good, and can be developed as the need arises. There are many impoundment sites for development of water based recreation.

Water quality is considered good and should not be a limiting factor for recreational developments.

Archeological, Historical, and Unique Scenic Resources

The National Register of Historic Places lists no features of archeological or historical significance within the watershed, nor are any listed as

eligible for inclusion. No sites are listed in Natural Areas of Indiana. 1/

An archeological and historical reconnaissance was made by a professional archeologist through the Indiana Historical Society. The reconnaissance covered all areas to be affected by installation of the structural measures. Four sites were located. Two of these will be inundated by reservoirs. The other two are located near reservoirs.

The following is taken from the report of the reconnaissance. 2/

> None of the prehistoric sites located during the survey appears to meet the criteria for inclusion on the National Register of Historic Places and, therefore, would not warrant permanent preservation. Likewise, given the current assessment of the project area for producing sites with sub-surface features, no sub-surface testing or excavation is called for. Finally, given our analysis of the sites located and the project area itself, no additional survey work is needed. The construction of the impoundment structures themselves, as well as anticipated secondary impacts of construction will not adversely affect significant prehistoric cultural resources.

In accordance with section 106, PL-89-665 and Executive Order 11593, a copy of the report was sent to the State Historic Preservation Officer. His concurrence is included in the letter of comment from the Indiana Department of Natural Resources included in Appendix G.

In accordance with PL-93-291, any evidence of other archeological sites uncovered during construction will be reported to the National Park Service and the State Historic Preservation Officer. Since this is a federally assisted local project, there will be no change in the existing responsibilities of any federal agency under Executive Order 11593 with respect to archeological and historical resources.

Soil, Water, and Plant Management Status

A comparison of land use for Dubois County in 1964 and 1969 is shown in the table below. Land in farms and total cropland decreased slightly. The amount of harvested cropland decreased while cropland used only for pastureland increased. This probably reflects an increase in the cropland diverted to other uses in the "feed-grain" and other cropland diversion programs in effect at this time.

Forest land acreage declined while other land uses increased. The difference in approximate land area figures indicates the acreage of lakes and ponds constructed during this period. Labor and capital

1/ Natural Areas in Indiana and Their Preservation. A. A. Lindsey, D. V. Schmelz, and S. A. Nichols. 1969.

2/ An Assessment of Historic and Prehistoric Cultural Resources of the Hall and Flat Creek Watershed Project, Dubois County, Indiana. Randall Guendling. Glenn A. Black Laboratory of Archeology, Indiana University, Bloomington, Indiana. January 1975.

resources are generally underinvested in the crop production process on watershed flood plain soils because of the risk of crop damage by flooding and impaired drainage.

Farm Land in Farms and Land Use 1/

Item	Year	Dubois County
Approximate land Area - Acres	1964	277,125
	1969	276,992
Land in farms Acres	1964	219,255
	1969	214,849
Percent in farms	1964	79.1
	1969	77.6
Total Cropland Acres	1964	142,032
	1969	139,780
Harvested Cropland Acres	1964	87,543
	1969	82,563
Cropland used only for pasture and grazing Acres	1964	27,132
	1969	30,114
All other cropland Acres	1964	27,357
	1969	27,103
Woodland including woodland Pasture - Acres	1964	53,352
	1969	47,847
All other land - Acres	1964	23,860
	1969	27,222

The importance of land treatment is recognized by the SWCD. Primary emphasis has been to assist in the development and implementation of complete conservation plans. These plans emphasize tree planting, pond construction, and installation of sediment and erosion control measures such as grade stabilization structures, diversions and grassed waterways, conservation cropping systems, and pasture and hayland planting.

Forty-seven percent of the watershed is covered by cooperative agreement with the SWCD. Approximately 45 percent (19,455 acres) of the watershed area is adequately treated. Of this, 41 percent is cropland, 21 percent is pastureland, 24 percent is forest land, and 14 percent is land in other uses.

1/ U.S. Department of Commerce. Social and Economic Statistics Administration. Bureau of the Census. 1969 Census of Agrilculture, Part II, "Indiana". Volume 1, Area Reports. Washington, D.C.: Government Printing Office.

Sixty-three watershed landowners are SWCD cooperators who have developed conservation plans covering approximately 21,265 acres. The soil survey for Dubois County is now being prepared. The following table reflects the current status of applied land treatment within the watershed.

STATUS OF WATERSHED WORKS OF IMPROVEMENT
(At time of Plan Preparation)

Hall-Flat Creek Watershed, Indiana

Measure	Unit	Applied To Date	Total Cost 1/ (Dollars)
LAND TREATMENT			
Soil Conservation Service			
Conservation Cropping System	Ac.	811	1,517
Contour Farming	Ac.	295	608
Crop Residue Management	Ac.	1,626	2,537
Critical Area Planting	Ac.	12	780
Diversions	Ft.	17,263	8,632
Drainage Field Ditch	Ft.	1,000	500
Drainage Main or Lateral	Ft.	44,482	80,068
Grade Stabilization Structure	No.	26	13,000
Grassed Waterways	Ac.	18	6,300
Holding Ponds and Tanks	No.	18	36,000
Minimum Tillage	Ac.	295	1,015
Pasture Management	Ac.	1,375	41,250
Pasture Planting	Ac.	2,123	159,225
Pond	No.	164	196,800
Spring Development	No.	5	1,500
Subsurface Drains	Ft.	478,537	215,342
Wildlife Upland Habitat Management	Ac.	103	3,863
Forest Service			
Management Plans	Ac.	1,400	4,000
Harvest Cutting	Ac.	320	3,500
TSI	Ac.	180	5,400
TOTAL			781,837

1/ Price Base: 1975

Projects of Other Agencies

The Wabash River Basin Comprehensive Study list Hall-Flat Creek Watershed under the early action plans. The Maltersville Reservoir, a U.S. Army Corps of Engineers Project, is listed under the Long Range Plan. Written communications from the Department of the Army, Corps of Engineers (Appendix G) states that "rapidly changing conditions, a lack of local support, and a low benefit to cost ratio (just above unity when studied) would seem to preclude any action on the implementation of this project for some time to come. At present, no funds are available for further study".

The Maltersville Reservoir would inundate much of the Hall-Flat Creek flood plain from which benefits were claimed for this plan. The Hall-Flat Creek Watershed Project would reduce much of the sediment requirements of the Maltersville Reservoir and some of the flood control requirements.

WATER AND RELATED LAND RESOURCE PROBLEMS

Land and Water Management

Many areas of the watershed currently under cultivation have soils with severe to very severe erosion limitations. Such areas should be converted to pasture-land or forest land uses. Much of the remainder of land under cultivation in the watershed has moderate drainage and erosion limitations. Ability of these soils to produce efficiently, both today and in the future, requires an expanded effort in applying needed practices and improvements.

Development of additional onfarm water resources is needed to complement existing pasture enterprise, to encourage needed land use adjustments, and to provide an environment more pleasing to man.

Overall economic capabilities of landowners and operators in the watershed should present no serious restrictions to application of needed land treatment practices and measures. An ambitious education and information program by the SWCD is needed to effectively reach and motivate watershed landowners and operators. The majority of their income is from nonfarm sources.

Floodwater Damage

Damage to crops, pastures, other agricultural properties, roads, and bridges are the principal floodwater problems in the watershed. These damages are associated with storms which generally occur two to three times per year.

Twenty-nine percent of these flood-producing storms occur during May, June, and July when crops are most susceptible to damage. The probability of floods occuring in any given month is shown in the following table.

Month	Chance of occurrence (percent)
January	12
February	13
March	15
April	14
May	11
June	10
July	8
August	3
September	2
October	2
November	4
December	6

The following table shows acres flooded by a 1-year frequency flood, 10-year frequency flood, and a 100-year frequency flood by reaches in the watershed.

Evaluation Reach	ACRES FLOODED BY REACH		
	1 Yr Flood Without Project	10 Yr Flood Without Project	100 Yr. Flood Without Project
1	419	457	472
2	635	670	687
3	659	717	744
4	397	431	443
5	213	237	244
6	39	66	74
7	210	265	288
8	768	919	948
9	327	438	481
TOTAL	3,667	4,200	4,381

The agricultural flood plain covers 4,381 acres and includes 3,344 acres of valuable cropland. Damage to crops and pasture from such flooding is extensive. Farmers have reported crop losses ranging from 20 percent up to 100 percent from the severe floods. Delayed planting and/or replanting associated with the flood problems causes increased crop production costs and decreased crop yields. Sediment deposition during flooding causes damage to plants by coating leaves with silt and clay.

Based on the monthly probability of flood occurence, crop and pasture damages for future conditions without project are estimated at $187,635 for the 100-year frequency flood event, $161,119 for the 10-year flood, and $115,994 for the one-year flood.

In addition to crop and pasture damages, flooding often results in underuse of floodplain land and excessive use of erosive upland. Because of high flood risks some areas of Class I and II floodplain soils have been left in trees while Class III and IV soils have been cropped intensively.

Time and expense are involved in removing debris from flood plain areas, repairing fences, farm roads, and tile outlets, removing sediment from drainage ditches, and controlling weed infestations carried in by floodwaters.

Interruption of travel, mail, and school bus service, and delay and inconvenience in feeding livestock constitute serious problems during flood periods. Flood damage is moderate to county roads and bridges in the watershed. Roads and bridge approaches are eroded by floodwaters.

Bridge foundations are undercut by floodwaters and in some cases are rendered unsafe for vehicular use. Road and bridge repairs are expensive and often travel is interrupted until repairs are made.

Erosion Damage

Sheet erosion occurs throughout the upland areas and accounts for 98 percent of the total erosion in the watershed. Approximately 87 percent of the watershed soils have erosion hazards. Soil losses on cropland in the upland

areas range from 3 to 26 tons per acre per year and average 5.6 tons per acre per year. After land treatment measures have been installed, the average gross sheet erosion rate will be 4.8 tons per acre per year. Reduction of sheet erosion to tolerable rates is needed to insure the continued productivity of the watershed soil resources.

Gully erosion is prevalent in the watershed but does not represent a major watershed damage. Such erosion occurs as gullies get longer, deeper, and form new lateral fingers. Areas affected are primarily in the steep uplands where average slopes are greater than five percent. Most lands affected are either in pastureland or forest land use. Steep channel gradients, high flow velocities, and poor land management, are prime contributors to the gully erosion problem.

Land damage from bank erosion and flood plain scour is severe in isolated segments of the watershed. Areas affected occur at intermittent points along Hall Creek and Flat Creek. Damage results from destruction of valuable cropland and through reduced agricultural production on areas less seriously affected.

Sediment Damage

Sediment damage is minor in the watershed. Sand and shale fragments drop out at the base of the steep ravines. The silts and clays move down the channels and are deposited at debris blocks and dams. Some minor channel fill occurs and some overbank deposits may be found. An estimated 22,272 tons of sediment leave the watershed annually.

Drainage Problems

Approximately 70 percent of the watershed flood plain soils are imperfectly drained which limits agricultural use. Over 70 percent of these soils are being used for crop production. Stendal is the primary wet bottom soil and Tilsit and Johnsburg are the upland soils with drainage problems. Bartle is an imperfectly drained soil occupying the terrace position just above the flood plain.

These soils will produce fair crops without artificial drainage but yields are usually depressed, crop quality reduced, and production costs increased. The remaining 30 percent of these imperfectly drained soils are in pastureland, forest land, recreation land, and urban land.

With drainage applied, the imperfectly drained soils are well suited for crops. They are usually poorly suited for urban and forest uses. Outlets for surface and subsurface drainage are generally adequate throughout the watershed to drain these soils. Needed drainage measures have been installed on approximately half of the affected area. High initial drainage costs and the threat of frequent flooding have limited installation of these drainage measures. With reduced flooding, installation of drainage measures is expected to increase in the future.

Recreation Problems

Public recreation within the watershed is deficient in nearly all aspects. However, the proximity of this watershed to several nearby developments

affords recreational opportunities for camping, boating, swimming, hiking, and picnicking. These existing facilities along with those planned in the adjacent Anderson River Watershed and those at Patoka Lake should adequately fulfill the recreational needs.

Plant and Animal Problems

Increased pressure for food production has resulted in a tendency of watershed landowners to crop erosion prone slopes beyond their capabilities, resulting in excessive erosion. This has resulted in a lower quality wildlife habitat on these areas.

Spring and summer flooding destroys eggs and the young of ground nesting animals and birds. Occasionally a brood year of a species within the flooded area could be adversely impacted, and, in some circumstances, completely eliminated by flooding. Effects of sediment laden floodwater and the decrease in water quality on fish have not been specifically evaluated.

There is a deficiency of natural wetland and waterfowl habitat as there are no natural lakes in the watershed. Surface water is limited primarily to farm ponds and a few miles of perennial streams.

Water Quality Problems

A water quality assessment of the watershed was conducted by the U.S. Geological Survey. 1/ Overall, the surface water in the watershed was found to be of good quality. For location of sample stations and analytical results refer to Appendix E.

The level of mineralization of the water was determined to be relatively low. Concentrations of dissolved iron were below problem causing levels, but dissolved maganese exceeded problem causing levels at most of the sample sites. Nutrient concentrations (nitrogen, phosphorus, and organic carbon) were determined to be normal for the area and time of year.

Nitrate concentrations were highest in cropped areas and lowest in forested areas. Fecal bacteria concentrations were significantly high at one sample site and indicated an animal waste source of bacteria.

In the Hall Creek sample site dieldrin, DDD, and DDE were detected in the bed materials. The Flat Creek and Straight River sites contained detectable concentrations of aldrin, dieldrin, heptachlor epoxide, DDD, and DDE. The occurence of these insecticides in the bed material indicates they are entering the waterways, and may enter local biological food chains. Good environmental conditions for well-balanced benthic communities were indicated by the biomasses and relative abundance of indicator organisms.

Economic and Social Problems

About 45 percent of the farms in Dubois County had total farm product sales less than $10,000 in 1969. Over 41 percent of the farmers in Dubois County

1/ Ayers, Mark A., 1975, A Water Quality Assessment of the Hall-Flat Creek Watershed, Dubois County, Indiana: Open-File Report, USDI, Geological Survey, Indianapolis, Indiana.

work 100 or more days off the farm. Income from crop sales account for less than 10 percent of the total cash farm receipts while livestock and poultry products account for nearly 90 percent of the farm receipts of Dubois County farms. 1/

Furniture factories and poultry processing plants in Jasper and nearby towns provide part time employment for farm operators desiring to supplement their farm income. Per capita and median family income for Dubois County are both slightly below the state average. In 1972 Dubois County had 2.3 percent of its work force unemployed, one of the lowest rates in the state. 2/

1/ U.S. Department of Commerce. Social and Economic Statistics Administration. Bureau of the Census. 1969 Census of Agriculture Part II, "Indiana". Volume 1, Section 1, Summary Data. Washington, D.C.: Government Printing Office, March 1972.

2/ Indiana Employment Security Division. Work Force Summaries for Smaller Counties in Indiana, Annual Average 1972.

RELATIONSHIP TO LAND USE PLANS, POLICIES, AND CONTROLS

Implementation of zoning ordinances in the State of Indiana is a power delegated to county government. No state or local land use master plan exists in the watershed area. No urban development has taken place in the flood plain due to frequent flooding and an abundance of good building sites in upland areas. The agricultural use of the flood plain will not change as a result of this project.

ENVIRONMENTAL IMPACTS

Conservation Land Treatment

Adequate land treatment to be installed on an additional 18,025 acres and partial land treatment on other acres will reduce average annual upland erosion from 5.6 tons to 4.8 tons per acre per year. Total watershed erosion will be reduced from 222,719 tons to 191,399 tons, a 14 percent reduction. This reduction in sediment deposition in streams and on the flood plain will result in proportionally reduced crop damages. Flood plain scour will be reduced on 381 acres. Sediment delivery to the Patoka River will be reduced approximately 46 percent (14 percent from land treatment and 32 percent from structures). The value of surface waters for fish and wildlife will be increased by reductions in sediment concentrations and associated fertilizers, pesticides, and animal wastes.

Land treatment includes crop residue management, minimum tillage, pasture and hayland planting, grassed waterways, diversions and grade stabilization structures. These will reduce erosion through interception or reduction of runoff and through stabilization of drainageways. Reduced sheet erosion will permit soil fertility to be maintained. Crop damage associated with poor stands will be reduced, as will permanent damage from gully erosion.

Pasture planting and management practices will improve overall quality and productivity. They will reduce erosion on approximately 5,800 acres of pastureland to be treated. Such areas when properly treated and managed complement the overall farm operation. They contribute significantly to farm income with a minimum of erosion risk. Approximately 50 ponds will be constructed resulting in better pasture management and improved fish and wildlife habitat.

Forest land treatment on 5,350 acres includes forest management planting, tree planting, hydrologic stand improvement, and woodland grazing control. These measures, properly installed and maintained, will reduce runoff and erosion from forest land by providing an effective layer of litter and humus on the soil surface.

Thirty-five acres with critical erosion problems will be stabilized by land treatment. This will reduce sediment concentrations in streams and preserve such areas for future use. At the same time it will restore natural beauty.

Approximately 4,100 linear feet of field borders will be planted. Wildlife habitat will be developed and managed on a total of 170 acres. The additional protective cover will increase and perpetuate wildlife. Critical area plantings, pasture planting, grassed waterways, and tree planting add to protective cover.

Voluntary land treatment will bring improved crop, pasture, and forest land management practices. These will enable farmers to achieve a better income from their various land use commitments. Pressures to commit watershed land resources in the short-run, to uses more intensive than are consistent with long-run capabilities, will be reduced.

Land treatment to be installed above structural measures will reduce quantity of sediment currently delivered to structure sites by 14 percent. This reduces the cost for sediment storage capacity and extends structural life. In addition, flood damage throughout watershed flood plain areas will be reduced by an estimated 6 percent.

Structural Measures

The 22 planned floodwater retarding structures are designed to reduce flood plain flooding. A table showing acres flooded and dollars damage without project and with structural measures only by a 1 year, 10 year, and 100 year flood event has been placed in Appendix F. This table also shows percent damage reduction by reach that is provided by structural measures. An additional 6 percent damage reduction in each reach is provided by land treatment. Much of the damage reduction is obtained by reducing floodwater depths.

Sediment pool areas of planned structures will inundate 7.1 miles of ephemeral feeder streams. The fishery, if any exists, will be destroyed by inundation and be replaced by a lake fishery.

Existing lakes or ponds will not be affected by the project. Wildlife wetland areas are virtually non-existent in the watershed. A type 3 wetland area (less than 3 feet deep) will be created in the upstream end and around the periphery of each reservoir sediment pool. The size of the wetland area will be approximately 10-15 percent of the surface area of the sediment pool, depending upon physical characteristics of the individual site.

Rare or endangered plant and animal species are not expected to be affected by installation of the proposed project. Ecological balance is not expected to change significantly within the project area.

Watershed flood damages will be reduced by 42 percent with the installation of structural measures.

A number of land use changes will occur in areas committed to the installation of structural measures. Current land use within structure sediment pool areas will be replaced by open water storage. The following table presents planned land use changes.

	Cropland	Pastureland	Forest Land	Total
Sediment Pool	123	52	54	229
Flood Pool	138	64	121	323
Flowage	5	3	5	13
Dam & Emergency Spillway	18	14	22	54
Total	284	133	202	619

The impact of these conversions on wildlife will be the replacement of 229 acres of terrestrial habitat by 229 acres of aquatic habitat. Dam and emergency spillway areas will be reshaped during construction and permanently vegetated with a mixture of herbaceous and/or wood plantings. Temporary disruption of wildlife will result from these conversions, but

under aged conditions these areas will evolve into grass and brush habitat offering a variety of food and cover plant species.

Relatively minor land use conversions will occur in flood pool areas (323 acres). Extent of these changes will be limited to shifts from cropland to pastureland. Periodic flooding of flood pool areas will cause temporary disruption of use by terrestrial wildlife, but will in turn create temporary aquatic habitat.

It is not anticipated that project measures will affect significantly the recoverability of the watershed's resources.

Approximately 1.5 miles of county roads will be abandoned due to installation of structural measures. Approximately one mile of county road will be constructed to facilitate travel around two structure sites. None of the road closings will significantly increase travel time for local residents.

Noise and air pollution will accompany construction activities. This will be localized in areas in close proximity to machinery. Cleared materials will be disposed of by methods approved by the Indiana State Board of Health.

All contracts for the construction of reservoirs will contain a special provision section which requires the contractor to install certain anti-pollution measures. Among these measures to be installed are:

1) desilting basin, located downstream of the construction project, to collect sediment which runs off of denuded areas. These basins are periodically cleaned out by the contractor as required.

2) terraces installed on sloping borrow areas to reduce the area subjected to runoff.

3) timely temporary seeding of denuded areas, especially if left over the winter from one season to another.

4) small levees constructed around fuel storage tanks to prevent the spreading of spillages.

5) watering down of haul roads to prevent dust from polluting the atmosphere.

6) plugging wells to prevent pollution of the underground water table.

Increased production on watershed lands benefiting from project measures is expected to increase the local tax base.

No known archeological, historical, or unique scenic resources will be affected by the proposed project measures. If any are identified during the reconnaissance, steps will be taken in accordance with Executive Order 11593 and Section 106, PL-89-665.

The degree of flooding to be experienced on various land uses for particular frequency floods will depend on the design class and features of the various

structures. All structures are classified as being low hazard. Land behind 14 of the structures will flood to crest on the emergency spillway on a frequency of once in 10 years. The remaining 8 structures will flood to the emergency crest on a frequency of once in 25 years. Flooding of the areas below emergency spillway crests will depend on the amount of rainfall and other hydrologic conditions at the time of the storm. Groundwater recharge will not be affected by this work.

A mobile home will be moved to reduce the hazard classification of structure No. 26. The District has determined that replacement sites are available within the general area.

Economic and Social

Reduced floodwater damage will enable small landowners to increase their crop and livestock production. This may enable some part time farmers to become full time farmers. Less risk of crop loss from flooding will encourage farmers to install drainage, apply increased amounts of fertilizer, seed, and chemicals to increase crop yields. More feed will be produced and livestock and poultry numbers increased. This increased farm production will in turn increase business for local merchants, haulers, and suppliers of farm production items.

Reductions in flood hazards will make it possible for farmers to more fully utilize flood plain land. An estimated 100 landowners will benefit directly from reduced flooding. An estimated 300 acres of such land will be converted from non-cropland uses to cropland as a result of the project. More intensive use of 1,523 acres of flood plain cropland will also result, as farmers increase the level of management used in the crop production process.

The following table summarizes flood plain land use changes.

Land Use	Without Project	With Project
Cropland	3,344	3,644
Corn	(2,879)	(3,133)
Beans	(303)	(329)
Wheat	(141)	(155)
Hay	(21)	(27)
Pasture	72	41
Woods and Misc.	965	696
TOTAL	4,381	4,381

A significant flood hazard will remain following project installation. Construction of buildings should be discouraged within the 100-year frequency "with project" flood boundary. Flood stages and discharges expected to prevail should be considered in the design of roads and bridges in flood plain areas. Flooding in such areas will be reduced, not eliminated. Farm management decisions as to intensifying production of agricultural crops should be carefully considered in view of anticipated damage reductions and remaining flood risks.

FAVORABLE ENVIRONMENTAL EFFECTS

a. Reduce annual erosion from 222,719 tons to 191,399 tons per year, a 14 percent reduction, by installing land treatment measures.
b. Reduce sediment concentrations in stream flows by 14 percent by installing land treatment measures.
c. Reduce sediment concentrations in stream flows an additional 32 percent with structural measures, for a total 46 percent reduction.
d. Stabilize 35 acres having critical erosion problems.
e. Implement wildlife habitat management and development plans on 170 acres.
f. Create 50 farm ponds complementing pasture enterprises and enhancing fish and wildlife values.
g. Reduce watershed flood damages by 6 percent with land treatment measures.
h. Reduce the inflow of fertilizers, pesticides and animal wastes into watershed streams.
i. Reduce watershed flood damages an additional 42 percent with structural measures.
j. Reduce flood plain scour on 381 acres.
k. Create 229 acres of open water beneficial to fish, terrestrial and aquatic wildlife.
l. Create an uplift in the overall watershed economy through secondary business support activities generated by the project.
m. Periodically create 323 acres of aquatic wildlife habitat in flood pool areas.
n. Increase benefits to upland wildlife by less intensive use of erosive cropland.
o. Adequately treat 18,025 additional acres, bringing the total to 37,480 acres (87 percent) of the watershed lands.
p. Create type 3 wetland on 10-15 percent of the sediment pools of the floodwater retarding reservoirs.
q. Improve quality and productivity on approximately 5,350 acres of private forest land.

ADVERSE ENVIRONMENTAL EFFECTS

a. Eliminate agricultural use of 141 acres in cropland, 66 acres in pastureland and 76 acres in forest land in dam, emergency spillway, and sediment pool areas of planned structures.

b. Produce local area reductions in the amount of wildlife habitat available through the inundation of 229 acres in structure sediment pools (includes 123 acres of cropland, 52 acres of pastureland, and 54 acres of forest land).

c. Interrupt pasturing activities, wildlife use, and other amenities such as esthetic quality, recreation value, and watershed protection on 64 acres of pastureland in structure flood pool areas and wildlife use on an additional 121 acres of forest land.

ALTERNATIVES

1. One alternative to the proposed action is no project. Adverse environmental effects of the planned improvements would be eliminated. However, a no project alternative also implies other adverse effects on the environment. Excessive erosion, continuing unchecked, will continue to defile the streams of the area with sediment. Upland and flood plain soil resources will continue to deteriorate at excessive rates without accelerated land treatment. An estimated $101,468 of annual net benefits resulting from the structural measures would be foregone if a no project alternative were selected.

2. Accelerated land treatment was another alternative considered. Practices and measures of two general types were analyzed. Namely (1) those which commonly appear in conservation plans and accrue benefits primarily onsite and (2) those installed for other purposes such as downstream flood reduction.

   Accelerated land treatment measures of the first type were found effective in meeting watershed needs for erosion protection, for onfarm water resource development (e.g.-farm ponds), and for agricultural drainage. In providing erosion protection, these measures were also found effective in reducing downstream sediment problems in the watershed. They would reduce annual erosion from 222,719 tons to 191,399 tons which means sediment contributions to stream flows are reduced by approximately 14 percent. These measures would adequately treat approximately an additional 18,025 acres of watershed land and create approximately 50 farm ponds. These measures did little toward reducing flood damage.

   This alternative would eliminate all adverse environmental effects except temporarily disrupting wildlife during construction of some of the major practices such as farm ponds and grassed waterways. Estimated cost of the land treatment is $562,217.

3. Another alternative considered was accelerated land treatment measures supplemented by nonstructural measures. Flood plain zoning is an effective means of preventing undesired development and reducing damages. Approximately 76 percent of the flood plain is cropland with a few utilities, roads, and bridges. Implementation of zoning ordinances is a power delegated to the county government in the State of Indiana. No zoning regulations currently exist within the watershed counties. Zoning would also be a means of converting flood plain land to a less intensive use although agriculture is usually considered compatible with periodic flooding. A method of flood plain management would be to convert 3,667 acres of cropland that is now flooded annually, to some less intensive use. The average annual net return foregone by converting this cropland to pastureland would be approximately $481,103. This alternative would not eliminate the flood damages that now occur, however it would prevent future development in flood prone areas. Environmental effects would be the temporary disruption of wildlife during construction

of some of the major practices of the accelerated land treatment segment such as farm ponds and grassed waterways. Cost of implementing this alternative would be $563,217 for land treatment measures plus the administrative costs to implement zoning.

4. Another alternative considered consisted of 28 single purpose floodwater retarding structures, 11.4 miles of channel work, and land treatment. The structures would have controlled drainage from 41 percent of the watershed area.

   This alternative provided 47 percent flood damage reduction at a total cost of $3,928,160. The average annual net costs would be $251,870 including operation and maintenance. The average annual benefits would be $288,135, with net benefits of $36,265.

   This alternative would destroy 25 acres of woody habitat along the channel as well as damage the stream fishery during construction activities on the channel. Effects of the 28 floodwater retarding structures would be somewhat greater than those for the selected plan, as 6 of the smaller structures are eliminated because of high costs.

5. Other alternatives consisted of a series of structural combinations, with channel work, supplemented by accelerated land treatment measures. The channel work would have provided a higher level of flood protection by increasing channel capacity. The unstable soils found along the channel would have required lining with stone. The cost of such a channel could not be economically justified and was therefore not included in the planned project.

   Several alternative structure sites were evaluated in various combinations. Those not selected were either not economically justified or provided a very low level of protection.

SHORT-TERM VS. LONG-TERM USE OF RESOURCES

Present use of watershed land is predominately agricultural. Exceptions to this are the small towns of Saint Anthony, Saint Marks, Schnellville, Celestine, and the communities of Kyana, and Maltersville. Future watershed land use is expected to remain essentially agricultural with minor incursions of acreage-type home site developments and private recreational retreats. Greatest concentration of this type development is expected in the lower one-half of the project area. To a considerable degree future land use in the watershed is expected to trend toward the development of its multiple use potential, particularly on the less intensively used agricultural areas such as forest land.

The planned system of land treatment and structural measures will do much to solve both short and long-term problems. Application of improved management practices and treatment needs under the land treatment program on cropland, pastureland, and forest land areas will enable watershed farmers to achieve a more favorable income balance from their various land use commitments. Pressures to commit watershed land resources in the short-run to uses more intensive than are consistent with long-term capabilities will thereby be reduced. In serving the profit motive, owners of these agricultural areas will also serve man and his environment through the perpetuation of much of the area's inherent natural beauty and protection of its natural resources. Reduction of flood problems on flood plain areas will also contribute to this end in allowing for increased profitability on currently cropped areas.

Planned project measures to be installed will complement projected long-term uses of land, water, and other natural resources which are outlined in the Ohio River Basin Comprehensive Survey. 1/ The project will yield onsite conservation benefits together with offsite benefits in the form of flood damage reduction, far beyond its evaluated 100-year life.

Many installed and potential watershed projects are found in this Ohio Region, and many applications for assistance are pending. The works of improvement in the Hall-Flat Creek Watershed will complement the Patoka Reservoir project of the U.S. Army Corps of Engineers a few miles to the northeast.

Hall and Flat Creeks join to form the Straight River approximately two miles upstream from where it empties into Patoka River. The Hall-Flat Creek Watershed comprises a small fraction of one percent of the Ohio River watershed or region. It is also part of the Patoka-White subregion as classified by the United States Water Resources Council, and makes up about 0.1 percent of that subregion. Because of the minute percentage of the region and subregion that this watershed occupies, any effect that this work would have on the region or subregion is considered negligible.

1/ Ohio River Basin Comprehensive Survey, Final Field Draft.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Structure permanent (sediment) pool areas will occupy 229 acres consisting of 123 acres cropland, 52 acres pastureland, and 54 acres forest land. Agricultural and upland wildlife uses in these areas will be foregone in creating 229 acres of water initially available for lake fishery and aquatic wildlife use. Seven and one-tenth miles of ephemeral feeder streams will be inundated by sediment pools.

Dams and emergency spillways will occupy an additional land area of 54 acres consisting of 18 acres cropland, 14 acres pastureland, and 22 acres forest land. Wildlife use of these areas will be interrupted during construction phases, but should become reestablished once vegetation of the construction areas is complete. Intensive agricultural use will be foregone in these areas.

Land use in flood pool areas of structures is composed of 138 acres of cropland, 64 acres of pastureland, and 121 acres of forest land for a total of 323 acres. Flooding in these areas will interrupt livestock and wildlife use and will limit the practice of intensive agricultural operations. Much of the current cropland area will revert to grass or "wild" areas.

Approximately 80 man years of labor will be invested in the completion of this project. In addition, earthmoving equipment and materials consisting primarily of concrete, steel, fertilizer, and grass seed will be required. The labor, equipment, and materials committed to construction is an irretrievably committed resource.

CONSULTATION AND REVIEW WITH APPROPRIATE AGENCIES AND OTHERS

General

In February 1966 the application for PL-566 watershed planning assistance was received by the Soil Conservation Service State Conservationist.

On September 5, 1967, a petition was filed for the formation of the Conservancy District.

On November 6, 1967, a copy of the Preliminary Investigation report was sent to the Department of the Interior, U.S. Fish and Wildlife Service.

In December 1967 there was a meeting with the Department of Health, Education, and Welfare and the Federal Water Pollution Control Administration on public water supply.

The Preliminary Investigation report was accepted by the Dubois County Soil and Water Conservation Board of Supervisors on January 3, 1968.

On January 9, 1968, the Indiana Natural Resources Commission held a public hearing on formation of the Conservancy District.

On September 13, 1968, the Soil Conservation Service received the Fish and Wildlife Report from the Department of the Interior, U.S. Fish and Wildlife Service.

In December 1968 the Dubois County Circuit Court established the Hall-Flat Creek Conservancy District and the directors thereof.

In February 1970, planning authorization was received from the Soil Conservation Service Administrator.

The Hall-Flat Creek Conservancy District has held annual meetings since it was formed in 1968. This meeting is held to inform the public of the status of the project as well as give them an opportunity to provide input. Notice of these meetings was published in local newspapers. The Conservancy District also has held quarterly meetings since its formation. These meetings are open to the public.

On February 3, 1975, SCS personnel met with the District to discuss their current objectives regarding the Hall-Flat Creek Watershed.

In March 1975 SCS personnel met with the District to tour the watershed. The purpose was to observe problem areas, structure sites, and the watershed in general.

On April 14 and 15, 1975, the Department of the Interior, Geological Survey, conducted field samplings of the streams in the watershed. A water quality report has been prepared and incorporated into this environmental impact statement.

On June 30 and July 1, 1975, a multi-agency review was made of the watershed to access the project's effects on fish and wildlife in the

watershed. Representatives of the USDA Soil Conservation Service, USDI Fish and Wildlife Service, and the Department of Natural Resources were on this trip.

In July, SCS personnel reviewed the first Preliminary Draft of the Work Plan and EIS with the Conservancy District Directors.

An archeological and historical reconnaissance was conducted by personnel of the Glenn A. Black Laboratory of Archeology. Their report was delivered to SCS in February 1976. A copy of the report was sent to the State Historic Preservation Officer. His concurrence is included in the letter of comment from the Indiana Department of Natural Resources included in Appendix G.

On February 10, 1976, the Hall-Flat Creek Conservancy District held a public meeting to review the Draft Plan and EIS. Approximately 70 people attended the meeting. Notice of the meeting appeared in local newspapers and letters of invitation were sent to 35 individuals, agencies, and groups. All landowners and tenants effected by the structures were invited to this meeting either by phone call or personal contact by one of the sponsors.

Discussion and disposition of each comment on draft environmental statement

Agencies from which written comments on the Draft EIS were requested.

*Department of the Army
Department of Commerce
*Department of Health, Education, and Welfare
*Department of the Interior
Department of Transportation
Office of Equal Opportunity - U.S.D.A.
*Environmental Protection Agency
Federal Power Commission
*Indiana Department of Natural Resources (for Governor)
Indiana State Clearinghouse
*Patoka Lake Regional Planning Commission
*Ohio River Basin Commission
Natural Resources Defense Council
Friends of the Earth
Environmental Defense Fund
National Wildlife Federation
National Audubon Society
Environmental Impact Assessment Project

* DID RESPOND

COMMENTS AND RESPONSES

Each issue, problem, or objection is summarized and a response given on the following pages. Comments are serially numbered. The original letters of comment appear in Appendix G.

Department of Army

1) Comment: A regional map would be helpful in illustrating the project area's relationship to population centers and major waterways.

Response: A fairly detailed description of the location of the watershed area exists at the beginning of the Environmental Setting, Physical Resources section of the EIS.

2) Comment: Information on aquatic populations in the project area is rather sparse. Considering the nature of this project, it might be advisable to conduct a field survey of aquatic species and include in the appendices a list of fish possibly affected.

Response: A list of fish species found in Southern Indiana has been added in Appendix C. A field survey of aquatic species in the watershed was conducted by Soil Conservation Service and U.S. Fish and Wildlife Service biologists. The species identified during that survey are noted in the list in Appendix C.

3) Comment: The section on water quality indicated a potential exists for significant degradation due to biological activity. Further information on the possibility of eutrophication in the impoundments could be discussed in the final.

Response: According to the U.S. Geological Survey study of the water quality in this watershed, it was determined that good environmental conditions for well-balanced benthic communities were indicated by the biomasses and relative abundance of indicator organisms.

Biological activity, does not appear to present a potential eutrophication problem in the impoundments. Eutrophication could be advanced, however, by high concentrations of nitrate to the extent that enrichment or undesirable biologic growth might occur, but not to the extent that public use would be restricted.

The installments of land treatment measures, which is an integral part of the plan, should adequately prevent this occurrence.

4) Comment: A glossary of technical terms would be helpful for the lay reader.

Response: Some of the more technical terminology has been defined or explained in the text of this report in order to eliminate the need for a glossary of terms.

5) Comment: In appendix C, it was noted that the "occurrence in area" was omitted for the Indiana bat.

Response: The Indiana bat is "possibly present" in the area and this information has been added to the list in Appendix C.

6) Comment: The larger streams in the Hall-Flat Creek Watershed, those with normal flows in excess of 5 cfs, will come under Corps' jurisdiction on 1 July 1977 in relation to Section 404 of Public Law 92-500. Any discharge of dredged or fill material below ordinary high water elevation on one of these streams after 1 July 1977 will require a Department of Army permit. The statement implies that most of the streams to be impounded are ephemeral. This jurisdiction does not include ephemeral streams but will normally extend to that point of the stream where normal flow is 5 cfs. In the case of water quality concerns, jurisdiction can be exercised over a stream where normal flow is less than 5 cfs.

Response: The sponsors are aware of Section 404 of Public Law 92-500. Most of the structures will not come under this jurisdiction. If any appear questionable, the Corps of Engineers will be consulted and an application for a construction permit made if required.

United States Department of the Interior

1) Comment: No provision is set forth in the watershed plan for minimum release of water from the 22 impoundments, particularly during dry periods of the year. In a 67.35 square mile watershed, runoff from 25.12 square miles (37 percent), will be intercepted by the impoundments. With approximately 15 percent of the runoff in the watershed subject to impoundment in the reservoirs, we are concerned with the effect of altered water supply (both in volume and periodicity) on existing fishery resources from the downstream portions of Hall-Flat Creek and Straight River.

Response: The 22 structures will reduce the peak flows from storm runoff. The runoff volume stored is automatically released through the principal spillway as the pools draw down to the sediment pool elevations. Evaporation losses are not appreciably different than the amounts used by crops and woodland and are generally replaced by the rain that falls directly on the pool.

2) Comment: The included list of fishes indicates that the watershed supports a diverse fishery resource. If a substantial volume of flow is withheld during dry periods, the result could be devastating to existing populations of fish and aquatic invertebrates in dewatered reaches of the streams.

Response: The list of fish found in the watershed have been included in Appendix C.

During dry periods the flow will be essentially the same as under existing conditions. For most years, the principal spillway is always open for release of temporary storage.

3) Comment: The following table presents the average flow in cubic feet per second (cfs) for water years 1971 through 1974 for Hall Creek at the U.S. Geological Survey gauging station located 3.3 miles north of St. Anthony, Indiana.

Average Stream Flow Data, Hall Creek

Month	Average Flow (cfs)
October	4.32
November	14.76
December	31.80
January	37.25
February	41.95
March	57.98
April	58.10
May	20.13
June	11.76
July	4.59
August	5.22
September	5.33

Since Flat Creek is similar in size to Hall Creek, we have assumed similar runoff data for Flat Creek. To provide minimum protection for aquatic resources in downstream reaches, and to augment natural unaltered flow, we recommend that daily minimum water releases be made from each dam and reservoir to total 1.0 cfs from July 1 through October 31 and 2.0 cfs from November 1 through June 30. The amount of release from each reservoir should be proportionate to the drainage area it intercepts.

Response: The augmentation of the existing flow was considered during plan formulation but no sponsors could be found to support the additional water storage needed for this purpose. At any time such sponsorship develops, the plan could be supplemented to add such a feature.

4) Comment: The plan indicates (pages I-13 and 14, now pages I-8 and 9) that as mitigation for wildlife habitat loss to project dams and reservoirs, the easement area from the flood pool line to the sediment pool line (323 acres) will be set aside as a wildlife area with appropriate permanent markers. This land will be allowed to revegetate by natural succession except for five conditions listed in the plan. These conditions may be applicable to all the impoundments, thereby eliminating or greatly reducing this mitigation feature.

We recommend that this section be supplemented with an analysis indicating the value of wildlife habitat to be destroyed, and which exceptions to the natural revegetation plan will be applicable on an acre basis at each of the 22 reservoir sites. This analysis also is necessary to provide meaning to the environmental statement in respect to what losses are anticipated and what degree of mitigation is being planned.

Response: Without the project much of the forest land at the impoundment sites would be converted to cropland or pastureland, since this is the general trend in the watershed. Of the 323 acres in flood pool areas, the 121 acres of forest land will be preserved and improved for wildlife by excluding livestock. Most of the 138 acres of cropland is expected to undergo natural habitat successional change from its present condition since risk of flooding will be great. These aspects provide adequate mitigation for the loss of 81 acres of forest land in sediment pools, flowage areas, and dams. This approach to mitigating wildlife losses for impoundments has been approved by a team of biologists from the Soil Conservation Service, U.S. Fish and Wildlife Service, and Indiana Department of Natural Resources.

5) Comment: If properly managed, it is our opinion that the 22 impoundments could be beneficial to fish and wildlife. Certainly, management of the existing impoundments (Numbers 50, 52, and 53) has benefited the fishery resources of the area. However, livestock should be excluded from having direct access to the proposed impoundment areas, as they apparently have been excluded from the existing impoundments. In addition to denuding the shore areas and increasing turbidity of the water, livestock can cause excessive algal blooms and accelerated plant growth. Increased eutrophication, caused by livestock waste, will lower the water quality, thus preventing successful production of quality sport fish.

Response: The Installation Provisions, Structural Measures section of the plan specifies that areas of the pool subject to pasturing will be fenced to exclude livestock. This requirement has also been included in Planned Project, Structural Measures section.

6) Comment: The environmental statement indicates that limited access for fishing may be provided to the general public for some of the pools if sufficient easements can be obtained without significant increase in cost. We fully support public access to all federally assisted reservoirs and suggest that detailed plans for achieving such access be included in the work plan. In addition, we recommend that appropriate impoundments be managed for waterfowl. The Department's Fish and Wildlife Service will offer technical assistance for waterfowl management upon request.

Response: Detailed plans for providing public access are not made at this time. We have had an unofficial commitment from the Indiana Department of Natural Resources to provide access roads and minimum facilities for incidental recreation, such as fishing and picnicking. The sponsors are also interested in providing recreational opportunities to the public. They intend to obtain the necessary easements from landowners at some of the larger impoundments (perhaps those that are 10 acres or larger). No specified number of developments are planned. The facilities will be developed as the demand occurs. Management of these public access areas will be the responsibility of the sponsors and the Department of Natural Resources.

7) Comment: The statement should consider how often and how long the structures will impound less than crest-level amounts and evaluate the effects of such temporary impoundments (including that of the volumes designated for ultimate sediment storage) on groundwater levels and adjacent land use.

Response: The structures are designed to impound crest-level amounts of water no more often than once in 10 years (for 14 structures) or once in 25 years (for 8 structures). The major portion of the temporary storage will be released within a 10 day period following each flood event.

All the structure sites are situated in areas characterized by ephemeral streams and correspondingly low water tables. Because of the tight surficial materials within the sediment and flood pool areas, the impoundments are, in essence, perched over the true water table, and recharge from the reservoirs to the ground water is therefore inconsequential under these conditions. Hence, the adjacent land use will not be affected.

8) Comment: Page II-7 (now page II-4) -- The statement should consider effects on groundwater of increased infiltration resulting from contour farming.

Response: Less than one percent of the watershed will be contoured. This will not have much effect on the groundwater through increased infiltration.

9) Comment: Page II-7 (now page II-4) -- Presumably all subsurface drainage of ground water will be beneficial, but this impact should be evaluated.

Response: Subsurface drainage will be used to remove the free or hydroscopic water only in the root zone layer to an average depth of two feet.

Subsurface drainage will be installed on cropland and primarily in the floodplain soils. Many acres have already been tiled and installation is continuing. No significant change in groundwater will occur by the removal of free water in the crop root zone area.

10) Comment: Page II-8 (now page II-6) -- Spring development by excavation should be more fully explained. Presumably no explosives would be involved which might destroy some types of springs; but if the purpose is solely to create catchment basins, this should be mentioned.

Response: The objective of spring development is to intercept the flow or seep, collect the water, and bring it to a central, usable location. Another objective may be to protect the water from contamination. The method of collection and protection varies depending upon the type of spring or seep. Often a perforated collector tile is installed in the soil where the spring is located and the water brought to a central watering tank for livestock and wildlife. Excavation is normally done by a backhoe or small trencher.

11) Comment: Page II-8 (now page II-6) -- Spring "capping" also needs more explanation; for an interruption of spring flow in one place (if this is the meaning) may result in troublesome breakouts elsewhere.

Response: Spring "capping" is used on very low yielding springs to obtain all the water that is pysically possible. The water is forced into a collection system for utilization. By design, the spring will come out only at the collection points.

12) Comment: Effects of erosion of coal mine tailings (page II-21, now page II-14, paragraph 4) by storm-water runoff on the chemical and physical quality of surface water should be assessed.

Response: The small amount of mining done in the watershed was small "hand" operations to provide local needs in the watershed area. No mining has been done in recent years. Coal mine tailings, if any, were very small piles and have become vegetated over the years. No active tailing erosion areas were observed or pointed out by local landowners during watershed project planning. The U.S.G.S. water quality report indicates no serious or unusual water quality problems.

13) Comment: The following fish and bivalve shells have been collected by Soil Conservation Service and U.S. Fish and Wildlife Service biologists in the watershed are; Straight River, Flat Creek, Hall Creek, and Grassy Fork on July 1, August 18 and 19, and September 4 and 5, 1975. We recommend this list be included in the final statement.

Fishes

Bowfin
Gizzard shad
Redfin pickeral
Carp
Stoneroller
Suckermouth minnow
Creek chub
Silverjaw minnow
Common shiner
Emerald shiner
White sucker
Brown bullhead
Madtom
Blackstripe topminnow
Starhead topminnow
Green sunfish
Longear sunfish
Bluegill
Johnny Darter
Rainbow darter

Bivalve Shells

Scientific Name	Common Name
Spaerium (Sp.)	Fingernail clam
Anodonta grandis grandis	Floater
Lasmigona complaneta	White heel-splitter
Uniomerus tetralasmus	Pond horn
Lampsilis teres	Slough sand shell
Lampsilis radiata luteola	Fat mucket
Ligumia subrostrata	Pond mussel
Leptodea fragilis	Fragile paper shell

Response: List included as part of appendix C.

14) Comment: We are pleased to note that the Soil Conservation Service has instituted appropriate procedures to locate and indentify cultural resources within the project area. While it is indicated on page 31 (now page II-21) that an archeological and historical reconnaissance of the 22 structure sites has been contracted for, the scope of the reconnaissance is unclear. The statement should provide assurance that the surveys undertaken have not been limited to structure sites alone but include all areas to be inundated, all borrow areas, any utility relocations or installations, all equipment storage sites, any grade stabilization structure location, and only areas in which subsurface drains will be installed.

Response: Narrative in the EIS has been changed to include the results of the archeological and historical reconnaissance. Also the scope of the reconnaissance has been made clearer.

15) Comment: The statement should confirm that the State Historic Preservation Officer, Mr. Joseph D. Cloud, has been consulted in making the determination that no sites that may be eligible for addition to the National Register of Historic Places would be affected by the proposed action.

Response: A copy of the archeological and historical reconnaissance was sent to the State Historic Preservation Officer on February 12, 1976 for his review. Based on the letter of comments from the Department of Natural Resources, of which he is director, he is in concurrence with the determination that no significant archeological or historical sites will be affected. Appropriate sections of this Final Environmental Impact Statement have been updated to include this information.

16) Comment: The watershed is underlain by the Mansfield Formation of Early Pennsylvanian age containing sandstone, limestone, clay, shale, and some coal. Coal is thin-bedded and of low quality in the watershed, but it is being strip-mined seven miles to the west. The nearest site of mineral production is a clay mine five miles away. No other mineral resources are known. Although we were unable to perform a field survey, we believe that the proposed project should have no significant effect on mineral production or resources.

Response: Comment noted.

17) Comment: Reference to converting 972 acres of forest land to cropland has been deleted in the subject statement. However, land use shifts will still result from the proposed action. Not only is the impact on fish and wildlife of converting 972 acres of forest land to cropland not addressed in the statement, but land use shifts resulting from the project have not been stated in the draft document. There are procedures available in which aerial photographs and field examinations are used to rate particular land areas to judge overall project impacts on wildlife. The value of land areas to be altered by the project are compared to those replacement areas which would be managed for wildlife with the project. The Fish and Wildlife Service is available to assist you in performing such an analysis.

Response: Converting forest land to cropland is the general trend in the area and is not a function of the proposed project. It has been estimated that the converting of 269 acres of flood plain woodland may be accelerated as a result of increased flood protection. The requirement of preserving woodland in the flood pools will save woodlands that may otherwise go to crop or pastureland if no project were installed.

18) Comment: The environmental statement should discuss the impact of the 22 reservoirs upon the flow regimes of the watershed and the aquatic resources supported therein. Fishes may have adapted to the spring high water conditions of the stream, taking advantage of adequate flows to migrate to headwater areas for spawning. This activity could be prevented by flow regulations, and, of course, migration past the impoundments will be stopped as there is no provision for upstream fish passage facilities.

Response: The main change in the flow regime as a result of the project is the peak discharges during flood conditions will be reduced. Low flows will not be significantly altered.

Fish will have the same adequate flows to migrate to headwater areas for spawning. Few, if any, fish are expect to migrate upstream as far as the structure sites. Those that do, have a chance to survive in the stilling pools that develop below the dams. Any fish that far upstream without the project are sure to perish since the streams dry up during summer months.

Environmental Protection Agency

1) Comment: This section was adequate with one exception. "Spring Development" needs to be explained in further detail. Attention should be given to the number of springs involved, and to the magnitude of excavation, structures, and facilities under consideration.

Response: It has been estimated that four springs will be developed at an average cost of $300.00, (Table 1A).

These low to medium flow type springs will be developed according to the standards and specifications as outlined in SCS National Engineering Handbook, Section 2.

These installations will provide water at locations which will achieve erosion control through better distribution of grazing or proper rotation grazing, and result in better grassland management. Excavation is normally done by either backhoe or trencher.

2) Comment: Information on water quality is very limited because it is chiefly the result of one day of sampling. Consequently, the conclusions (on pages 20 and 32, now pages II-13 and II-28) that water quality within the watershed is "good" should be presented with caution. A better assessment of water quality would be possible if additional data was available.

Response: The objective of the U.S.G.S. water quality study was to delineate present and/or potential water quality problems within the watershed in order to provide basic data for evaluation.

Although the results are based on two sample collection periods, several biological parameters relating to the long-term effects of stream quality were investigated according to U.S. Environmental Protection Agency methods (E.P.A., 1973, "Biological Field and Laboratory Methods for Measuring Quality of Surface Waters and Effluents": Environmental Monitoring ser., Macroinvertebrates sec., pp. 26-31).

The benthic communities were determined to be clean-water types, i.e., organisms generally intolerant of even moderate reductions in dissolved oxygen and other types of pollution stress. A lack of organic enrichment was indicated by the determination of the pollution tolerance index for the phytoplankton communities. Good environmental conditions and well-balanced benthic communities were indicated by the biomasses (class Insecta) and relative abundance of good indicator organisms.

Inasmuch as the condition and diversity of a stream's biological community reflect the combined effects of water quality and streamflow through time, it is not unreasonable to infer from these results that the water quality of the Hall-Flat Creek Watershed is good.

3) Comment: Information on point and non-point sources of pollution should be provided. The discussion on page 20 (now pages II-13 and 14) that an animal waste source is suspected of causing high fecal bacteria concentrations at one sampling point should have been discussed in further detail. Feedlots and other potential sources of pollution should be located and addressed.

Response: The primary non-point sources of pollution are sediment and, to a lesser extent, insecticides. These problems are discussed on pages II-41 through II-44 (now pages II-25 through II-29) in the "Water and Related Land Resources Problems" section.

The only point-source of pollution delimited by the U.S.G.S. study was an animal waste source at site No. 22 (see Appendix E for location). The pollutant was indicated by significantly high concentration of fecal bacteria. Because the site is located downstream of all structure sites, there is no possibility of it polluting the water upstream of the proposed structures.

4) Comment: It appears that none of the small communities within the watershed have sewage treatment plants of any kind. Septic systems must be in use, but the EIS does not address this. Due to the small size of these communities, and since they are not incorporated entities, it is very unlikely that Section 201 grants for sewage treatment will be applied for or awarded. The watershed does not lie within a specific designated Section 208 study area. In addition, the Section 303e basic plan for this part of Indiana is not complete.

Response: Comment noted.

5) Comment: Long-term runoff information from the one stream gaging station indicated on the map in Appendix E should be provided if available. A major discussion within the EIS resolves around the number of acres flooded by annual, 10 year, and 100 year floods. The criteria that were used for determing these various flood stages (annual, 10 year and 100 year) should be discussed in detail.

Response: No long-term runoff information is available from the stream gage in the watershed since it was only installed in 1970. The short record for this gage does indicate that the

runoff characteristics for Hall-Flat Creek are similar to other watersheds in that part of the state. Using this information and standard Soil Conservation Service methods for computing runoff, flood stages were determined for various frequency events. The hydraulic capacity of the channel and valley were determined with the aid of the Soil Conservation Service computer program WSP2. Flood routing was done with the Soil Conservation Service computer program TR20 and acres and dollar damages were computed with the use of Soil Conservation Service computer program ECON II.

6) Comment: The relationship between this proposed project and the proposed Maltersville Reservoir Project should be examined in more depth.

Response: More information on status of the Maltersville reservoir project has been added.

7) Comment: Specific water quality problems are not identified in this section. Instead, the discussion of water quality found in the Environmental Setting is merely shortened and repeated.

Response: Non-point sources of water quality problems are discussed in this section. Comment No. 3 above discusses the specific point-source problem area.

8) Comment: Information provided on page 40 (now page II-26) is unclear and misleading. Crop and pasture damage <u>without</u> the project is estimated to be $117,556 for the annual flood. It should be explained if these damages are being incurred every year, or if they are estimates of damage which would result if flood plain acreage not being used for agriculture was converted to agricultural use.

It is implied on page 40 (now page II-26) that the flood plain is "underused" because much of it has grown back into timber. This is very subjective. In our opinion, woodlands is a very appropriate use of flood plain land.

Response: Based on the monthly probability of flood occurrence listed on page II-39, without project crop and pasture damages are estimated at $187,635 for the 100 year frequency flood event, $161,119 for the 10 year frequency flood, and $115,994 for the 1 year frequency flood. The average annual crop and pasture damages without project is estimated to be $250,766. Average annual damages are based on a weighted composite of all expected flood frequencies including small floods that occur on the average more often than once each year.

Land well suited to growing grain crops is scarce and very high priced in Dubois Co. and Hall-Flat Creek Watershed.

As crop prices and land values both increase landowners become willing to take greater flood risks in order to increase crop acreages. Therefore, in the future more land is expected to be cleared of low economic value woodland and placed in higher economic value cropland both on the flood plain and upland. Without project flood damages are expected to be higher under future conditions than under present conditions.

9) Comment: In addition to discussing noise and air pollution, water quality impacts should be discussed, particularly the effects of construction activities. The EIS should include a discussion on construction practices which will minimize water quality impacts. Silt retention dams should be constructed to control siltation from the construction of the small impoundments.

Response: All contracts for the construction of reservoirs will contain a special provision section which requires the contractor to install certain anti-pollution measures. Among these measures to be installed are:

1) desilting basin, located downstream of the construction project, to collect sediment which runs off of denuded areas. These basins are periodically cleaned out by the contractor as required.

2) terraces installed on sloping borrow areas to reduce the area subjected to runoff.

3) timely temporary seeding of denuded areas, especially if left over the winter from one season to another.

4) small levees constructed around fuel storage tanks to prevent the spreading of spillages.

5) watering down of haul roads to prevent dust from polluting the atmosphere.

6) plugging wells to prevent pollution of the underground water table.

This information has been added to the EIS, Environmental Impacts Structural Measures Section.

10) Comment: Creation of 229 acres of open water beneficial to fish, terrestrial, and aquatic wildlife is listed as a favorable environmental impact on page 55 (now page II-35). On page 56 (now page II-36), the inundation of approximately 7.1 miles of ephemeral feeder streams within sediment pools is listed as an adverse environmental impact. If streams

feeding these open water pools are ephemeral, it should be indicated how the pools will maintain water levels during dry periods. If they were to dry up quite regularly, their creation should only be viewed as a degrading impact which would not be beneficial to fish and aquatic wildlife. This point should be addressed in the EIS.

Response: Inundation of over 7 miles of ephemeral streams with sediment pools may not be an adverse environmental impact and has been deleted from the list of adverse effects.

The streams feeding the proposed sediment pools of the 22 structures are ephemeral and normally do not flow at least part of the hot dry months of July, August, and September. Evaporation during these dry periods will reduce the water level and depth to some extent during dry years when little summer runoff occurs. However, they will not dry up, nor will the depth or size be reduced sufficiently to endanger the fish and other aquatic wildlife.

Strucutre numbered 41 has the smallest ratio of drainage area to surface area - 40:1. There are presently 4 private lakes inundating ephemeral streams all with smaller drainage area to surface area ratios than structure No. 41. These lakes have experienced no problem of drying up nor have the fish and aquatic wildlife been adversely affected. There are many farm ponds throughout the watershed with drainage area to surface area ratios of 10:1 or less that remain nearly full of water through dry periods and sustain good population of bass and bluegill.

11) Comment: The EIS should provide more information on the proposed pools behind flood retarding structures. A description should be included of the pool dimensions and depths.

Response: Sediment pools range in size from 3.7 acres to 24.1 acres, an average of 10.4 acres. Floodwater pools range in size from 10.1 acres to 65.8 acres, an average of 25.1 acres. An average 61 acre-feet of sediment will accumulate in the sediment pools of each structure over the 100 year life of the project. An average of 209 acre-feet of floodwater will be temporarily stored to the crest of the emergency spillway of each structure.

Sediment pool depths at the dams will range from 4.0 feet to 19.5 feet, an average of 11.0 feet. However, since sediment pools are the primary borrow sources, the final average depth of each structure will be somewhat greater. The initial volume of water contained in the sediment pools will be displaced by sediment over the 100 years design life of the structures.

This information has been added to the EIS, Planned Project, Structural Measures Section.

12) Comment: A description should be included of the nature and quality of pool releases, water quality within the pool, fish and aquatic wildlife which will inhabit the pools, and management practices.

Response: No water quality problems have been indicated in the four existing reservoirs, one of which (Schnellville Conservation Lake) has been operating for about 38 years. Because of the remarkable similarity of factors of hydrology, soils, climate, sizes of drainage areas, drainage patterns, topography, and land use, it is not unreasonable to expect similar conditions of water quality to occur in the proposed impoundments. Hence, water quality should not be a limiting factor to fish and aquatic wildlife populations. The usual stocking of the pools is bass, bluegill, and channel cat. Technical assistance for management of these pools is available from SCS, IDNR, and USFWS.

Indiana Department of Natural Resources

1) Comment: However, the Report will still have to contain sufficient information so that a technical review can be made. We could not find what level of protection will be provided by the project.

Response: The planned project provides approximately a 48 percent damage reduction. This is equal to approximately a two year crop season level of protection. Additional information regarding present damage reduction has been added in the first paragraph under "Benefits-Monetary", page I-9,(now page I-6). Level of protection in the form of percent damage reduction is shown on page II-49 and II-50 (now page 32) and elsewhere in the EIS.

2) Comment: The plan should contain a profile of the routed storms for the without project and with project conditions.

Response: To prevent bulkiness and to provide meaningful information to a diversified group of readers a table was added in Appendix F in lieu of profiles. This table shows discharge (cfs) and elevations for with and without project conditions for all cross-sections evaluated in the plan.

3) Comment: The table on page II-49 (now page 32) could be improved by showing the dollar damages in addition to the acres flooded.

Response: A table showing without and with project structural measures, acres, and dollars damages by reach for the 1, 10, and 100 year floods has been placed in Appendix F.

4) Comment: Page II-12 (now page II-8) states that a levee will be constructed below site No. 79, but there is no other information about the levee in the report.

Response: As per letter from Mr. Cloud to A. J. Wetzel dated 9/29/75 the "a" hazard classification of structure No. 79 will be adequate if a levee is constructed to protect the house from a breach wave. The levee will be appróximately 25 feet in height, have a top width of 12 feet, and have side slopes of 2½:1. It will be an extension of the right abutment past the house so that, if a breach does occur, the wave will be deflected downstream. The house is located approximately 400 feet downstream and 75 feet back into a side valley.

5) Comment: On page II-52 (now page II-34), it states that the emergency spillway of 14 structures will be put into operation at a 10 year frequency and 8 structures at a 25 year frequency. These numbers are reversed according to Table 3. We thought

the criteria for a class "a" structure was the containment of a 25 year frequency storm below or at the crest of the emergency spillway.

Response: The "Frequency Operation Emergency Spillway" line in Table 3 has been revised. Eight of the proposed 22 structures are designed under SCS Engineering Memorandum 27 which sets emergency spillway crests at the 10 day - 25 year run-off elevation. These structures will have emergency spillways that flow once in 25 years (4 percent chance). The remaining 14 structures are small enough in size to be designed under Engineering Standard 402-1 which sets emergency spillway crests at the 10 year - 24 hour rainfall elevation. Three of these 14 structures have emergency spillways that will flow once in 10 years (10 percent chance). Eleven of these structures have emergency spillways that have been perched to provide more retarding volume. The emergency spillways of these structures will flow less frequently than once in 10 years.

6) Comment: Page II-37 (now pages 23 and 24) contains a reference to the Wabash River Basin Comprehensive Study. In that study, an estimate was made for reduction of flood flows out of Hall-Flat Creek Watershed, when evaluating the effects on Patoka River. How does the reduction of flood flows from the proposed Hall-Flat Creek Watershed Project compare with the estimates made during the Wabash River Basin Comprehensive Study?

Response: The Hall-Flat Creek Watershed Project considered in the Wabash River Basin Report contained 8 structures controlling 25.8 square miles. This plan contains 22 structures controlling 25.1 square miles. The reduction of flood flows at the outlet of Hall-Flat Creek Watershed is similar with either system of control.

7) Comment: The Project Map shows four structures in place. Are these structures part of the proposed watershed project? Were these existing structures given credit for any floodwater retarding effect in the hydraulic routings?

Response: The four in place structures shown on the project map are not a part of the proposed project. They were used in all with and without project routings and therefore any floodwater retarding effects they have is a part of all conditions studied.

8) Comment: On page II-11 (now page II-7) a statement is made that "All structures are designed with an expected life of 100 years". Is this statement correct?

Response: The statement is correct. All structures are designed with 100 year sediment pools and principal spillways are constructed with reinforced concrete having a design life of over 100 years.

9) Comment: The plan states, on page II-11 (now page II-8), that a county road will be constructed across the top of the dam on structure No. 32. In the case of this proposed construction, a bridge is required to cross the emergency spillway. It is the Natural Resources Commission's policy to only consider a road crossing an emergency spillway when the frequency of use is no more often than once in one hundred years.

Response: Road crossings thru the spillway will be designed during the operations phase to conform to state criteria.

10) Comment: The table on page II-49 (now page II-32) gives data for evaluation reach XI. Reach XI is not shown on the Project Map.

Response: References to Reaches X and XI have been deleted from all tables, since the project had no effect on these reaches.

11) Comment: There are no known historical or architectural sites affected by this project, but if any archaeological sites are discovered during construction, they should be reported to this office.

Response: Comment noted.

LIST OF APPENDICES

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APPENDIX D - FIGURE NO. 1 - CROSS SECTION ALONG PRINCIPAL SPILLWAY

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WATER QUALITY FIELD DATA
WATER QUALITY CHEMICAL DATA

APPENDIX F - DISCHARGE AND DAMAGE TABLES

APPENDIX G - LETTERS OF COMMENT

Approved by Clarence A. Gallimore
State Conservationist

Date May 6, 1976

APPENDIX A

COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Hall-Flat Creek Watershed, Indiana
(Dollars)

Evaluation Unit	AVERAGE ANNUAL BENEFITS 1/					3/	
	Damge Reduction	Changed Land Use	More Intensive Use	Secondary	Total Benefit	Avg. Annual Cost	Benefit Cost Ratio
All Structural Measures	143,028	40,562	41,094	27,980	252,664	133,657	1.9:1
Project Administration	: : :	: : :	: : : :	: : : :	: : : :	17,539	: : : :
GRAND TOTAL	143,028 2/	40,562	41,094	27,980	252,664	151,196	1.7:1

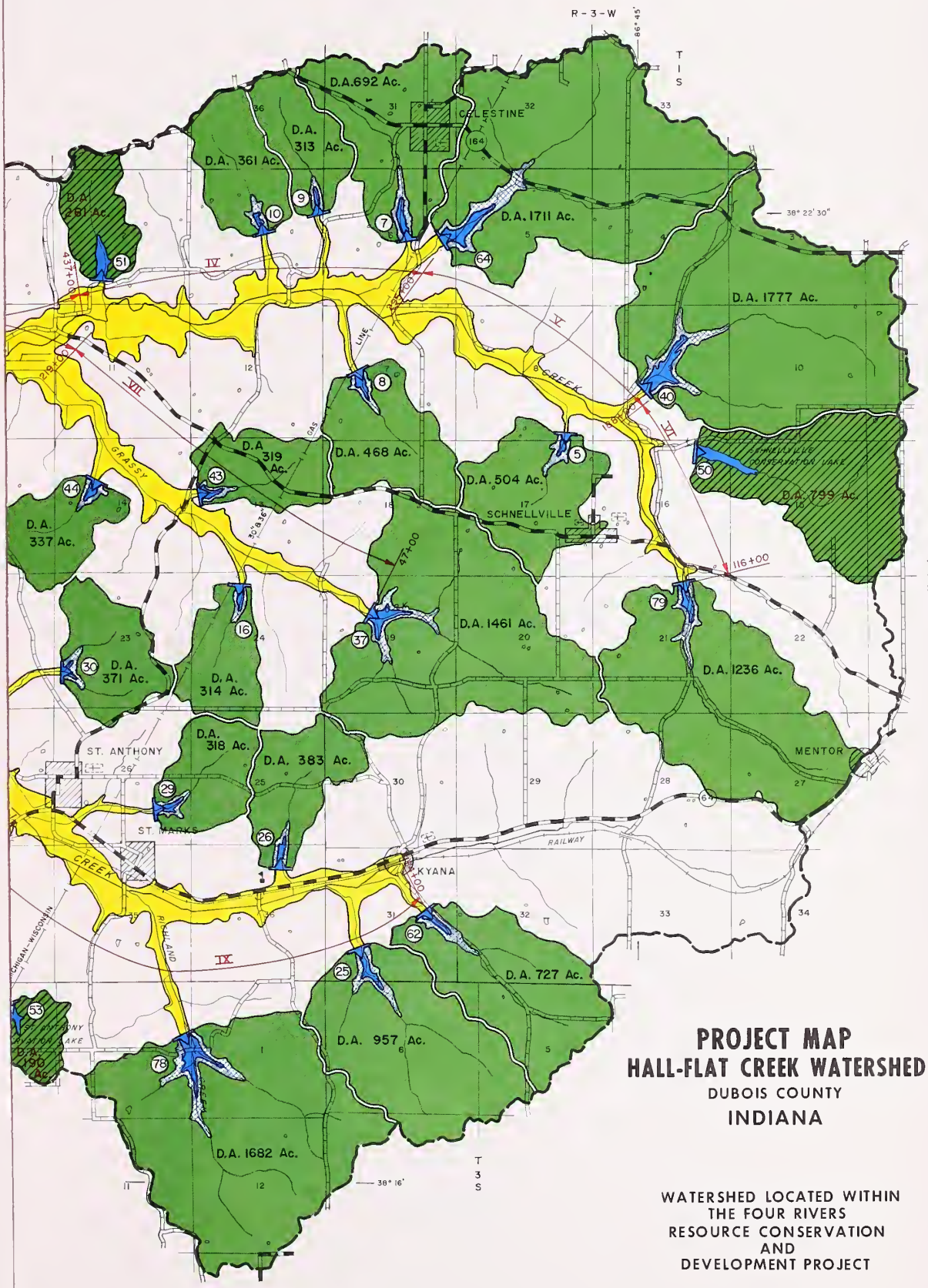
1/ Price base: Current normalized prices as approved by Water Resources Council - November 1975 for agricultural items and 1975 prices for other items.

2/ In addition, it is estimated that land treatment will provide flood damage reduction benefits of $17,033 annually.

3/ Price base: Installation and O&M 1975. Installation costs amortized over 100 years at 6 1/8 percent interest.

April 1976

APPENDIX B



PROJECT MAP
HALL-FLAT CREEK WATERSHED
DUBOIS COUNTY
INDIANA

WATERSHED LOCATED WITHIN
THE FOUR RIVERS
RESOURCE CONSERVATION
AND
DEVELOPMENT PROJECT

3-23-76
5,S-35,464

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

PROJECT MAP
HALL-FLAT CREEK WATERSHED
DUBOIS COUNTY
INDIANA

WATERSHED LOCATED WITHIN
THE FOUR RIVERS
RESOURCE CONSERVATION
AND
DEVELOPMENT PROJECT

LEGEND

- TOWNSHIP LINE
- SECTION LINE
- SECTION NUMBER
- PAVED ROAD
- GRAVEL ROAD
- DIRT ROAD
- RAILROAD
- CROSSING (GRADE)
- PIPELINE
- CROSSING (ROAD UNDER)
- BRIDGE
- SCHOOL
- CEMETERY
- CITY
- DRAINAGE
- POND OR DAM
- WATERSHED BOUNDARY
- DRAINAGE AREA CONTROLLED BY STRUCTURE
- AREA BENEFITED
- STRUCTURE NUMBER
- FLOOD RETARDING STRUCTURE
- STRUCTURE DRAINAGE AREA (D.A. 594 Ac.)
- REACHES
- STRUCTURES IN PLACE PRIOR TO 1976

INDIANA

SCALE 1 1/2 0 1 MILES
SCALE 1/63,875

SOURCE:
SCS BASE 5,S-25,133 (REV. 10-17-67)
AND INFORMATION FROM FIELD
TECHNICIANS
(POLYCONIC PROJECTION)

3-23-76
5,S-35,464

APPENDIX C

REPTILES AND AMPHIBIANS IN THE HALL-FLAT CREEK WATERSHED AND VICINITY

NAME	COMMENTS
Common Snapping Turtle Chelydra serpentina	Range covers the state
Stinkpot (Musk Turtle) Sternothaerus odoratus	Range covers the state
Eastern Mud Turtle Kinosternon subrubrum subrubrum	Range covers NW & SW corner of state
False Map Turtle Graptemys pseudogeographica	*Range covers SW corner of state
Ouachita Map Turtle Graptemys pseudogeographica ouachitensis	*Range covers SW corner of state
Map Turtle Graptemys geographica	Range covers the state
Midland Painted Turtle Chrysemys picta marginata	Range covers the state
Slider Pseudemys concinna hieroglyphica	Range covers extreme SW corner of state
Red-Eared Turtle Pseudemys scripta elegans	Range covers W½ of state
Eastern Box Turtle Terrapene carolina carolina	Range covers the entire state except small section of NW corner
Smooth Softshell Trionyx muticus	Range covers S edge, SW corner & S½ of W side of state
Eastern Spiny Softshell Trionyx spinefer spinifer	Range covers the state
Northern Fence Lizard Sceloporus undulatus	Range covers S½ of state
Ground Skink Lygosoma laterale	Range covers SW corner of state

NAME	COMMENTS
Five-Lined Skink Eumeces fasciatus	Range covers the state except small area in NW corner
Broad-Headed Skink Eumeces laticeps	*Range coves S½ of state
Six-Lined Race Runner Cnemidophorus sexlineatus	Range covers extreme NW corner & SW corner of state
Western Earth Snake Haldea valeriae elegans	Range covers SW¼ of state
Northern Red-Bellied Snake Storeria occipitomaculata	Range covers SW¼ of state
Midland Brown Snake Storeria dekayi wrightorum	Range covers state
Midland Water Snake Natrix sipedon pleuralis	Range covers S 1/3 of state
Kirtland's Water Snake Natrix kirtlandi	Range covers the state except SW corner
Norther Copper-Belly Water Snake Natrix erythrogaster neglecta	Range covers SW corner, NE corner & area in S Central part of state
Diamond-Backed Water Snake Natrix rhombifera rhombifera	Range covers SW corner of state
Queen Snake Natrix septemvittata	Range covers the state except SW corner & area in NW corner
Butler's Garter Snake Thamnophis butleri	Range covers N 2/3 of W½ of state
Eastern Garter Snake Thamnophis sirtalis sirtalis	Range covers the state
Eastern Ribbion Snake Thamnophis sauritus sauritus	Range covers the state except area in NW corner

* May be present in other parts of the state

NAME	COMMENTS
Eastern Hognose Snake Heterodon platrhinos	Range covers the state
Midwest Worm Snake Carphophis amoenus helenae	Range covers the S½ of state
Northern Ringneck Snake Diadophis punctatus edwardsi	*Range covers the S½ of state
Southern Black Racer Coluber constrictor priapus	Range covers S 1/3 of state
Western Smooth Green Snake Opheodrys vernalis blanchardi	Range covers NW, SW corners and area in center of state
Rough Green Snake Opheodrys aestivus	Range covers S½ of state
Bullsnake Pituophis melanoleucus sayi	Range covers two small areas in the NW & SW corner of state
Black Rat Snake Elaphe obsoleta obsoleta	Range covers the state except area in NW corner
Red Milk Snake Lampropeltis doliata syspila	Range covers SW corner
Prairie King Snake Lampropeltis calligaster calligaster	Range covers W¼ of state
Black King Snake Lampropeltis getulus niger	Range covers SW¼ of state
Southern Crowned Snake Tantilla coronata	Range covers center of state along Ohio River
Northern Copperheads Agkistrodon contortrix mokeson	Range covers S½ of state

NAME	COMMENTS
Timber Rattlesnake Crotalus horridus horridus	Range covers S½ of state
Hellbender Crptobranchus alleganiensis alleganiensis	Range covers southern edge of state
Mudpuppy Necturus maculosus	Range covers the state
Western Lesser Sirens Siren intermedia nettingi	Range oovers W¼ & area 3/4 across Central part of state
Central Newt Diemictylus viridescens louisianensis	Range oovers W½ of state
Red-Spotted Newt Diemictylus viridescens viridescens	Range covers E½ of state
Blue-Spotted & Jefferson Salamanders Ambystoma laterale	Range covers E 3/4 & NW corner of state
Spotted Salamander Ambystoma maculatum	Range covers the state except small area of NW corner
Small-Mouthed Salamander Ambystoma texanum	Range covers the state except area along W 3/4 of N state line
Marbled Salamander Ambystoma opacum	Range covers S 3/4 of state
Eastern Tiger Salamander Ambystoma tigrinum tigrinum	Range covers the state
Red-Backed Salamander Plethodon cinereus cinereus	Range covers the state exoept small area of the NW corner
Zigzag Salamander Plethodon dorsalis dorsalis	Range covers S edge & area up center of state to W edge

* May be present in other parts of the state

NAME	COMMENTS
Northern Two-Lined Salamander Eurycea bislineata bislineata	Range covers S 2/3 of state
Slimy Salamander Plethodon glutinosus glutinosus	Range covers S½ of state
Four-Toed Salamander Hemidactylium scutatum	Range covers S½ of state except SW corner & N edge of state
Long-Tailed Salamander Eurycea longicauda longicauda	Range covers S½ of state
Cave Salamander Eurycea lucifuga	Range covers S½ of state
Eastern Spadefoot Scaphiopus holbrooki	Range covers S edge of state
American Toad Bufo americanus	Range covers the state except SW¼
Fowlers Toad Bufo woodhousei fowleri	Range covers the state
Northern Spring Pepper Hyla crucifer crucifer	Range covers the state
Eastern Gray Tree Frog Hyla versicolor versicolor	Range covers the state
Blanchard's Cricket Frog Acris crepitans blanchardi	Range covers the state
Western Chorus Frog Pseudacris triseriata triseriata	Range covers the state
Upland Chorus Frog Pseudacris triseriata feriarum	Range covers S½ of state
Pickerel Frog Rana palustris	Range covers the state except areas of NW & SW corners
Southern Leopard Frog Rana pipiens sphenocephala	Range covers W 3/4 of S½ of state
Northern Crowfish Frog Rana areolata criculosa	Range covers S 3/4 of W½ of state
Green Frog Rana clamitans melanota	Range covers the state
Wood Frog Rana sylvatica	Range covers the state
Bullfrog Rana catesbeiana	Range covers the state

This information is from Peterson's Field Guide of Reptiles & Amphibians.

MAMMALS OCCURRING IN THE VICINITY OF THE HALL-FLAT WATERSHED

Name	Habitat	Notes on Local Populations
Opossum Didelphis marsupialis	Farming areas & Woodlands	Common-definitely present
Shortail shrew Blarina brevicauda	Unrestricted	Common-definitely present
Least shrew Cryptotis parva	Open grass-covered areas and marshes	Probably present
South eastern shrew Sorex longirostris	Moist situations-in dense grass	Probably present
Eastern mole Scalopus aquaticus	Gardens, fields and meadows-avoids dry soil	Probably present
Keen's myotis Myotis kennii	Caves, mine tunnels hollow trees or buildings, storm sewers forests	Probably present
Little brown myotis Myotis lucifugus	Caves, mine tunnels, hollow trees, and buildings	Probably present
Indiana myotis Myotis sodalis	Caves in winter-manmade structures and hollow trees in summer	Possibly present
Silver-haired bat Lasionycteris noctivagans	Wooded areas	Probably present
Big brown bat Eptesicus fuscus	Caves, mine tunnels, rock crevices, near water, wooded ares, buildings	Probably present
Eastern pipistrelle Pipistrellus subflavus	Well wooded areas Probably roosts in trees during day	Probably present
Gray myotis Myotis grisescens	Caves	Rare-may be present
Evening bat Nycticeius humeralis	Buildings & hollow trees	Possibly present
Red bat Lasiurus borealis	Wooded areas	Probably present
Hoary bat Lasiurus cinerus	Wooded areas	Possibly present
Eastern cottontail Sylvilagus floridanus	Heavy brush, strips of forest with open areas nearby, edges of swamps, weed patches	Definitely present
Eastern gray squirrel Soiurus carolinensis	Hardwood forests with nut trees, river bottoms	Commonly-definitely present

Name	Habitat	Notes on Local Populations
Eastern fox squirrel Sciurus niger	Open hardwood lots in north, pine forests with clearings in south	Common-definitely present
Eastern chipmunk Tamias	Deciduous forests, brushy areas	Probably present
Southern flying squirrel Glaucomys volans	Woodlots and forest of deciduous or mixed deciduous & coniferous trees	Undoubtedly present
Woodchuck Marmota monar	Open woods, brushy & rocky ravines	Common-definitely/probably present
Beaver Castor canadensis	Streams & Lakes with trees or alders on bank	May be present
Muskrat Ondatra aibethica	Marshes, edges of ponds, lakes and streams, cattails, water lilies	Undoubtedly present
Deer mouse Peromuscus maniculatus	Open to brushy or wooded areas, dry land	Definitely present
White-footed mouse Peromusus leucopus	Woody or brusy areas preferred, sometimes open areas	Definitely present
Southern bog lemming Synaptomus cooperi	Low damp bogs and meadows with heavy growth of vegetation	May be present
Pine vole Microtus pinetorum	Usually a forest flood with a thick layer of duff, deciduous in north, pines in south	Possibly present
Prairie vole Microtus ochrogaster	Open pariries, fence rows, r.r rights-of-way and old cemetaries feeding, but appears in various land habitats not restricted	Possibly present
Coyote Canis latroms	Prairies, open woodlands brushy or boulder strewn areas	Not common-might be present
Red fox Vulpes fulva	Mixture of forest & open country preferred	Common-present
Gray fox Urocyon cinereoargenteus	Chaparral, open forests & rimrock country	Fairly common-probably present
Raccoon Procyn lotor	Along streams & lakes borders, near wooded areas or rock cliffs	Common-definitely present
Longtail Weasel Mustela frenata	Not restricted-near water	Not uncommon-probably present
Mink Mustela vision	Along streams & lakes	Common-present

Name	Habitat	Notes on Local Populations
Striped skunk Mephitis mephists	Semi-open country, mixed woods, open prairie & brush land preferred	Common-definitely present
White tail deet Odocoileous virginianus	Forest, swamp & open brushy areas nearby	Definitely present

BIRDS OCCURRING IN THE VICINITY OF THE HALL-FLAT WATERSHED

Species	Migrant or Resident	Habitat Preference	Occurrence in Area
LOONS			
Common Loon *Gavia immer*	M	Large Lake	Rarely
Red-throated Loon *Gavia stellata*	M	Lakes	Rarely
GERBES			
Horned Gerbe *Colymbus auritus*	M	Ponds & Lakes	Rarely
Pied-billed Gerbe *Podilymbus podioeps*	R&M	Ponds & marshes	Common M, Uncommon
Double-crested Cormorant *Phalacrocorax auritus*	M	Large lakes & rivers	Rarely
HERONS			
Great Blue Heron *Ardea herodies*	SR&M	Any shallow water	Common
Green Heron *Butorides virescens viresoens*	SR&R	Any shallow water	Common
Little Blue Heron *Florida caerulea caerulea*	M	Wet fiels	Uncommon
Cattle Egret			
American Egret *Casmerodius albus egretta*	SR&M	Any shallow water	Occasionally
Black-crowned Night Heron *Nycticorax nycticorax hoaotli*	M	Ponds & marshes	Uncommon
Yellow-crowned Night Heron *Nyctanassa violacca*	M	Marshes	Unoommon
BITTERNS			
Least Bittern *Ixobrychus exilis exilis*	SR&M	Cattail marshes	Common M; Unoommon SR
American Bittern *Botaurus lentiginosus*	SR&M	Marshes	Common M; Unoommon SR
SWANS			
Mute Swan *Cygnus olor*	M	Ponds & lakes	Rarely
Whistling Swan *Cygnus columbianus*	M	Ponds & lakes	Rarely

Species	Migrant or Resident	Habitat Preference	Occurence in Area
GEESE			
Canada Goose Branta canadensis	SR&M	All water and fields	Common M; Uncommon SR
White-fronted Goose Anser albifrons	M	All water & fields	Occasional
Snow (Blue) Goose Chen caerulescens	M	All water & fields	Common
DUCKS			
Mallard Anas platyrhynchos platyrhynchos	R&M	All water	Common
Black Duck Anas rubripes	WR&M	All water	Common
Gadwall Anas strepsra			
Pintail Anas acuta tzitzihoa	M	All water	Common
Green-winged Teal Anas carolinensis	M	All water	Common
Blue-winged Teal Anas discors	SR&M	All water	Common
American Widgeon Mareca americana	M	All water	Common
Shoveler Spatula clypeata	M	All water	Common
Wood Duck Aix sponsa	SR&M	All water, near woods preferred	Common
Redhead Aythya amerioana	M	All water, open areas preferred	Common
Ring-necked Duck Aythya collaris	M	All water	Common
Canvasback Aythya valisineria	M	All water, open areas preferred	Common
Greater Scaup Aythya marila nearctica	M	All water, open areas preferred	Uncommon
Lesser Scaup Aythya affinis	M	Al water, open areas preferred	Common

Species	Migrant or Resident	Habitat Preference	Occurence in Area
Common Goldeneye Glaucionetta clangula americana	WR&M	All water, open areas preferred	Common
Borrow's Goldeneye Glaucionetta islandica	M	All water, open areas preferred	Uncommon
Bufflehead Glaucionetta albeola	M	All water, open areas preferred	Common
Ruddy Duck Erismatura jamaicensis rubida	M	All water, open areas preferred	Uncommon
Hooded Merganser Lophodytes cucullatus	SR&M	All water, near woods preferred	Rare, SR, Common M
American Merganser Mergus merganser americanus	M	All water, open areas preferred	Common
Red-breasted Merganser Mergus serrator	M	All water, open areas preferred	Common
VULTURES			
Turkey Vulture Cathartes aura	R	All areas, some woods preferred	Common
Black Vulture Coragyps atratus	SR		Uncommon
HAWKS & EAGLES			
Goshawk Accipitersgentilis atricopillus	M	Forested areas, especially coniferous	Rarely
Sharp-skinned Hawk Accipter striatus velox	R	Wooded areas	Common
Cooper's Hawk Accipiter cooperii	R	Wooded areas	Uncommon
Red-tailed Hawk Butero jamaicensis	R	Open woods and marshes	Common
Red-shouldered Hawk Buteo lineatus	R	Open woods	Common
Broad-winged Hawk Buteo platypterus platypterus	SR	Deciduous woods	Uncommon
Roug-legged Hawk Buteo lagopus	WR	Open areas	Occasional
Golden Eagle aquilachrysaetos cinadensis	M	Wooded areas	Rarely
Bald Eagle Haliaeetus leucocephalus	M	Wooded areas near water	Rarely

Species	Migrant or Resident	Habitat Preference	Occurrence in Area
Marsh Hawk Circus cyaneus hudsonius	R&M	Marshes, fields	Common
Osprey Pandion haliaetus carolinensis	M	Near water	Occasional
Peregrine Falcon Falco peregrinus anatum	M	Cliffs, high buildings	Rarely
Pigeon Hawk or Merlin Falco columbarius columbarius	M	Woodlands	Rarely
Sparrow Hawk or American Kestrel Falco sparverius	R&M	Open areas	Very common
UPLAND GAME BIRDS			
Bobwhite Colinus virginianus	R	Brushlands	Common
CRANE			
Sandhill Crane Grus canadensis	M	Marshes and open areas	Occasional
RAILS			
King Rail Rallus elegans elegans	SR&M	Marshes	Common
Virginia Rail Rallus limicola limicola	SR&M	Marshes	Common
Soro Porzana carolina	SR&M	Marshes	Common
Yellow Rail Coturnicops noveboracensis noveboracensis	M	Wet meadows	
Black Rail Laterallus jamaicensis pygmaeus	M	Grassy edges of marshes	Rarely
Florida Gallinule Gallinula chloropus cachinnans	SR&M	Marshes	Common
Coot Fulica ameriana	SR&M	All water	Common
PLOVER			
Simipalmated Plover Charadrius hiaticula semipalmatus	M	Wet fields	Uncommon
Killdeer Charadrius vociferus vociferus	R&M	Fields, open areas often near water	Common
American Golden Plover			

Species	Mirgrant or Resident	Habitat Preference	Occurrence in Area
Black-bellied Plover *Squatarola squatarola*	M	Wet meadows, fields, and marshes	Uncommon
American Woodcock *Philohela minor*	SR&M	Swamps, wet woods, and thickets	Common
Common Snipe *Copeia glainago delicaia*	M	Meadows and marshes	
Upland Plover *Bartramia longicauda*	SR&M	Pastures & prairies	Ocoasional
Spotted Sandpiper *Actitis macularia*	SR&M	Water edges	Common
Solitary Sandpiper *Tringa solitaria solitaria*	M	Water edges	Uncommon
Greater Yellowlegs *Totanus melanoleucus*	M	Marshes & shallow water areas	Uncommon
Lesser Yellowlegs *Totanus flavipes*	M	Marshes & shallow water areas	Common
Pectoral Sandpiper *Erolia melanotos*	M	Grassy marshes	Uncommon
Baird's Sandpiper *Erolia bairdii*	M	Grassy areas & shore lines	Uncommon
Least Sandpiper *Erolia minutilla*	M	Wet fields	Uncommon
Dunlin *Calidris alpina*	M	Water edges	Uncommon
Short-billed Dowitcher *Limodromus griseus*	M	Marshes, water	Uncommon
Simipalmated Sandpiper *Ereunetes pusillus*	M	Water edges	Uncommon
Hudsonian Godwit *Limosa haemastica*	M	Marshed, wet fields & water edges	Uncommon
Sanderling *Crocethia alba*	M	Water edges	Occasional
Wilson's Phalarope *Stegaropus tricolor*	SR	Shallow water areas	Rarely
Northern Phalarope *Lobipes lobatus*	M	Ponds & lakes	Rarely

Species	Migrant or Resident	Habitat Preference	Occurrence in Area
GULLS			
Herring Gull Larus argentatus	R&M	Open water areas	Common
Ring-billed Gull Larus delawarensis	R&M	Open water areas	Common
Bonaparte's Gull Larus philadelphia	M	Open areas, often near large streams	Uncommon
TRENS			
Common Tren Sterna hirundo hirundo	M	Open water areas	Common
Black Tren Chlidonias nigra surinamensis	M	Marshes, shallow water areas	Common
DOVES			
Rock Dove Columbalivia	R	Buidlings	Common
Mourning Dove Zenaidura macroura	R&M	Open woodlands & farmlands	Common
CUCKOOS			
Yellow-billed Cuckoo Coccyzus amerianus americanus	SR&M	Second growth woods and thickets	Common
Black-billed Cuckoo Coccyzus erythrophtalmus	SR&M	Second growth woods and thickets	Common
OWLS			
Barn Owl Tyto alba pratincola	R	Wood edges and farmlands	Uncommon
Screech Owl Otus asio	R	Open woods	Common
Great Horned Owl Bubo virginianus	R	Deep woods	Common
Snowy Owl Nyctea scandiaca	M	Marshes and farmlands	Rarely
Barred Owl Strix viria	R	Moist woods	Common
Long-eared Owl Asio otus wilsonianus	WR	Evergreens or mixed woodlands	Common
Short-eared Owl Asio flammeus flammeus		Marshes, meadows and open areas	Common
Saw-whet Owl [illegible]		Evergreens and [illegible]	[illegible]

Species	Migrant or Resident	Habitat Preference	Occurrence in Area
Whip-poor-will Caprimulgus vociferus	SR&M	Woods near fields	Common
Nighthawk Chordeiles minor	SR&M	Open areas	Common
Chimmney Swift Chaetura pelagica	SR&M	Open areas near buildings	Common
Ruby-throated Hummingbird Archilochus colubris	SR&M	Gardens & areas with wild flowers	Common
Belted Kingfished Megaceryle alcyon alcyon	SR&M	Water edges	Common
WOODPECKERS			
Yellow-shafted Flicker Colaptes auratus	SR&M	Wood edges & open woods	Common
Red-bellied Woodpecker Centurus carolinus	R	Woods, edges & swamps	Common
Red-headed Woodpecker Melanerpes erythrocephalus	R	Open woods & farmlands	Common
Yellow-bellied Sapsucker Sphyrapicus varius varius	WR	Wooded areas	Common
Hairy Woodpecker Dendrocopus villosus	R	Wooded areas	Common
Downy Woodpecker Dendrocopus pubescens	R	Open woods & edges	Common
FLYCATCHERS			
Eastern Kingbird Tyrannus tyrannus	SR&M	Farms, meadows, & water edges	Common
Great Crested Flycatcher Myiarchus crinitus	SR&M	Wooded areas	Unoommon
Eastern Phobe Sayornis phoebe	SR&M	Farmlands & stream edges	Common
Yellow-bellied Flycatcher Empidonax flaviventris	SR&M	Stream edges	Uncommon
Acadian Flycatcher Empidonax virescens	SR&M	Woodlands	Uncommon
Traill's Flycatoher Empidonax traillii traillii	M	Dry uplands Stream edges &	Uncommon

Species	Migrant or Resident	Habitat Preference	Occurrence in Area
Least Flycatcher *Empidonax minimus*	M	Streams edges & farmlands	Common
Eastern Wood Pewee *Contopus virens*	SR&M	Pine woods & shade trees	Common
Olive-sided Flycatcher *Nuttallornis borealis*	M	Woods near water	Occasional
HORNED LARK *Eremophila alpestris*	R	Open areas and marshes	Common
SWALLOWS			
Tree Swallow *Iridoprocne bicolor*	SR&M	Open areas near water	Common
Bank Swallow *Riparia riparia*	SR&M	Meadows, ponds, & bankds	Uncommon
Rough-winged Swallow *Stelgidopteryx ruficollis serripennis*	SR&M	Open areas near water	Common
Barn Swallow *Hirundo rustica erythrogaster*	SR&M	Meadows and marshes near open water	Common
Cliff Swallow *Petrochelidon pyrrhonota albifrons*	SR&M	Meadows & marshes	Uncommon
Purple Martin *Progne subis subis*	SR&M	Meadows & open grassy areas	Common
BLUEJAY *Cyanocitta cristata*	R	Woods & edges	Common
COMMON CROW *Corvus brachyrhynchos*	R	Fields & woods	Common
BLACK-CAPPED CHICKADEE *Parus atricapillus*	R	Woods & edges	Common
TUFTED TITMOUSE *Parus bicolor*	R	Swamps & woods	Common
White-breasted Nuthatch *Sitta carolinensis*	SR&M	Wooded areas	Common
Red-breasted Nuthatch *Sitta canadensis*	WR	Wooded areas	Uncommon
Brown Creeper *Certhia familiaris*	WR	Woods & swamps	Common

Species	Migrant or Resident	Habitat Preference	Occurrenoe in Area
WRENS			
House Wren Troglodytes aedon	SR&M	Woods, thickets & farmlands	Common
Winter Wren Troglodytes troglodytes	WR	Thickets & brush lands	Uncommon
Bewick's Wren Thryomanes bewickii	SR	Woods, thicket & farmlands	Uncommon
Carolina Wren Thryothorus ludovicianus	R	Swamps, woods & thickets	Occasional
Long-billed Marsh Wren Telmatodytes palustris	SR&M	Cattail Marshes	Uncommon
Short-billed Marsh Wren Cistothorus plantensis stellaris	SR&M	Grassy Marshes	Common
Mockingbird Mimus polyglottos polyglottos	R	Farmlands & towns	Common
Catbird Dumetella carolinensis	SR&M	Thickets & fencerows	Common
Brown Thrasher Toxostoma rufum rufum	SR&M	Thickets	Common
THRUSHES			
Robin Turdus migratorius	R	Open areas & swamps	Abundant
Wood Thrush Hylocichla mustelina	SR&M	Moist woods	Common
Hermit Thrush Hylocichla guttata faxoni	M	Moist Woods	Uncommon
Olive-backed Thrush Hylocichla ustulata	M	Woodlands	Occasional
Grey-cheeked Thrush Hylocichla minima	M	Woodlands	Occasional
Veery Hylocichla fuscesens	M	Swamps & wet woods	Uncommon
Eastern Bluebird Sialia silalis	R&M	Wood edges 7 farmlands	Common
Blue-gray Gnatcatcher Polioptila caerulea caerulea	SR	Thickets & swamps	Uncommon

Species	Migrant or Resident	Habitat Preference	Occurrence in Area
Golden-crowned Kinglet *Regulus satrapa satrapa*	M&WR	Thickets & swamps	Common
Ruby-crowned Kinglet *Regulus calendula calendula*	M	Thickets & swamps	Uncommon
Water Pipit *Anthus spinoletta rubescens*	M	Fields	Rarely
Bohemian Waxwing *Bombycllagarrulus pallidiceps*	R&M	Woodlands & edges	Occasional
Cedar Waxwing *Bombycilla cedrorum*	R&M	Woodlands & edges	Common'
Northern Shrike *Lanis excubitor borealis*	WR&M	Open areas & swamps	Occasional
Loggerhead Shrike *Lanis ludovicianus*	SR&M	Farmlands	Occasional
Starling *Sturnus vulgaris vulgaris*	R	All areas	Very Abundant
VIREO			
White-eyed Vireo *Vireo griseus*	SR&M	Thickets near water	Common
Bell's Vireo *Vireo bellii bellii*	SR&M	Thickets	Uncommon
Yellow-throated Vireo *Vireo flavifrons*	SR&M	Open woodlands	Uncommon
Solitary Viero *Vireo solitarius*	M	Open woodlands	Uncommon
Red-eyed Vireo *Vireo olivaceus*	SR&M	Woodlands	Common
Philadelphis Vireo *Vireo philadelphicus*	M	Wood edges near water	Occasional
Marbling Vireo *Vireo gilvus gilvus*	SR&M	Open woodlands	Occasional
WARBLERS			
Black & White Warbler *Mniotilta varia*	SR&M	Woodlands	Common
Prothonotary Warbler *Protonotaria citrea*	SR&M	Swamps & moist woods	Uncommon
Worm-eating Warbler *Helmitheros vermivorus*	S[illegible]	Wo[illegible]ds	U[illegible]on

Species	Migrant or Resident	Habitat Preference	Occurrence in Area
Golden-winged Warbler *Vermivora chrysotera*	M	Thickets & wood edges	Uncommon
Blue-winged Warbler *Vermivora pinus*	M	Thickets & wood edges	Uncommon
Tennessee Warble *Vermivora peregrina*	M	Thickets & woodlands	Common
Orange-crowned Warbler *Vermivora celata celata*	M	Open woods	Occasional
Nashville Warbler *Vermivora ruficapilla*	M	Wood edges	Common
Parula Warbler *Parula americana*	SR&M	Swamps & wood edges	Common
Yellow Warbler *Dendroica petechia*	SR&M	Swamps & thickets near water	Common
Magnolia Warbler *Dendroica magolia*	M	Woodlands & edges	Common
Cape May Warbler *Dendroica tigrina*	M	Wood edges	Uncommon
Black-throated Blue Warbler *Dendroica caerulescens*	M	Open woods	UnCommon
Myrtle Warbler *Dendroica coronata coronata*	M	Open woods	Common
Black-throated Green Warbler *Dendroica virens*	M	Woods, often conifers	Common
Cerulean Warbler *Dendroica cerulea*	SR&M	Open woods	Common
Blackburnian Warbler *Dendroica fusca*	M	Deep woods	Common
Yellow-throated Warbler (Sycamore) (*Dendroica dominica*)	SR&M	Moist woodlands	Occasional
Chestnut-sided Warbler *Dendroica pensylvanica*	M	Second growth woods & thickets	Common
Bay-breasted Warbler *Dendroica castanea*	M	Open woods	Common

Species	Migrant or Resident	Habitat Preference	Occurrence in Area
Blackpoll Warbler *Dendroica striata*	M	Open woods	Common
Pine Warbler *Dendroica pinus*	M	Open woods	Uncommon
Prairie Warbler *Dendroica discolor*	SR&M	Second growth woods	Uncommon
Palm Warbler *Dendroica palmarun*	M	Open areas & swamps	Common
Ovenbird *Seiurus aurocapillus*	SR&M	Woodlands	Common
Northern Waterthrush *Seiurus noveboracensis*	M	Stream sides	Uncommon
Louisiana Waterthrush *Seiurus motacilla*	SR&M	Marshes and stream edges	Uncommon
Kentucky Warbler *Oporornis formosus*	SR&M	Moist thickets & swamps	Uncommon
Connecticut Warbler *Oporornis agilis*	M	Moist Thickets & swamps	Uncommon
Mourning Warbler *Oporornis philadelphia*	M	Moist thickets & swamps	Common
Yellow Throat *Geothlypis trichas*	SR&M	Thickets	Common
Hooded Warbler *Wilsonia citrina*	M	Thickets near water	Common
Wilson's Warbler *Wilsonia pusilla pusilla*	M	Thickets near water	Common
Canada Warbler *Wilsonia canadensis*	M	Thickets near water	Common
American Redstart *Setophage ruticilla*	M	Woodlands & swamps	Common
English Sparrow *Passer domesticus domesticus*	R	All areas	Very abundant
Bobolink *Dolichonyx oryzivorus*	M	Marshes & meadows	Common
Eastern Meadowlark *Sturnella magna*	R	Marshes & meadows	Common

Species	Migrant or Resident	Habitat Preference	Occurrence in Area
Western Meadowlark *Sturnella melecta*	R	Marshes & meadows	Occasional
Yellow-headed Blackbird *Xanthocephalus*	SR	Fields, marshes & farmlands	Rarely
Red-winged Blackbird *Agelaius phoeniceus*	R	Fields, marshes & edges	Abundant
Orchard Oriole *Icterus spurius*	SR&M	Orchards & farmlands	Uncommon
Baltimore Oriole *Icterus galbula*	SR&M	Open woods	Common
Rusty Blackbird *Euphagus carolinus*	M	Swamps, marshes & fields	Uncommon
Brewer's Blaokbird *Euphagus cyanocephalus*	SR	Farmlands	Uncommon
Common Grackle *Quiscalus quiscula*	R	All areas	Abundant
Brown-headed Cowbird *Molothrus ater ater*	SR&M	Open areas	Common
Summer Tanager *Piranga rubra rubra*	SR&M	Woodlands	Occasional
Soarlet Tanager *Piranga olivacea*	SR&M	Woodlands	Common
Cardinal *Richmondena oardinalis*	R	Thickets	Common
Rose-breasted Grosbeck *Pheucticus ludovicianus*	M	Open woods, edges & thickets	Common
Indigo Bunting *Passerina cyanea*	SR&M	Brush lands & edges	Common
Dickcissel *Spiza americana*	SR&M	Meadows & prairies	Common
Purple Finch *Carpodacus purpureus purpureus*	WR&M	Woodlands	Common

Species	Migrant or Resident	Habitat Preference	Occurrence in Area
Evening Grosbeck *Hesperiphona vespertina*	WR&M	Wood edges	Common
Pine Grosbeck *Pinicola enucleator leucura*	WR	Wood edges	Occasional
Common Redpoll *Acanthus flammea*	WR	Swamps & fields	Common
Pine Sisking *Spinus pinus pinus*	WR&M	Woodlands & thickets	Common
American Goldfinch *Spinus tristis tristis*	R	Open areas	Common
Red Crossbill *Loxia curvirostre*	WR&M	Coniferous area	Occasional
White-winged Crossbill *Loxia leucoptera leucoptera*	WR	Coniferous area	Occasional
Rufous-sided Towhee *Pipiloerythrophthalmus*	R	Woodlands, edges & thickets	Common
SPARROWS			
Savannah Sparrow *Passerculus sandwichensis*	M	Water edges & meadows	Unoommon
Grasshopper Sparrow *Ammodramus savannarum*	SR&M	Meadows & farmlands	Uncommon
LeConte's Sparrow *Passerherbulus caudacutus*	M	Marshes & meadows	Uncommon
Sharp-tailed Sparrow *Ammosiza caudacuta*	M	Marshes	Occasional
Vesper Sparrow *Popecetes gramineus gramineus*	WR&M	Dry meadows	Common
Lark Sparrow *Chondestes grammacus grammacus*	M	Dry meadows & open woods	Uncommon
Bachman's Sparrow *Aimophila aestivalis*	SR&M	Open woods & brushlands	Occasional
Slate-colored Junoo *Junco hyemalis*	WR&M	Edges & open areas	Common
Oregon Junco *Junco oreganus*	WR	Edges & open areas	Rarely
Tree Sparrow *Spizella arborea arborea*	SR&M	Brushlands & second growth woods	Common

Species	Migrant or Resident	Habitat Preference	Occurrence in Area
Chipping Sparrow *Spizella passerina passerina*	SR&M	Wood edges & meadows	Common
Clay-colored Sparrow *Spizella pallida*	SR&M	Meadows & brush lands	Occasional
Field Sparrow *Spizella pusilla pusilla*	R	Meadow & brushlands	Common
Harris Sparrow *Zonotrichia querula*	WR	Thickets	Common
White-crowned Sparrow *Zonotrichia leucophrys*	M	Thickets	Common
White-throated Sparrow *Zonotrichia albicollis*	WR&M	Thickets	Common
Fox Sparrow *Passerella iliaca iliaca*	WR&M	Open woods, edges & thickets	Common
Lincoln's Sparrow *Melospiza lincolnii lincolnii*	M	Wet areas, thickets & edges	Common
Swamp Sparrow *Melospiza georgina*	WR&M	Marshes & swamps	Common
Song Sparrow *Melopiza melodia*	R	Thickets	Common
Smith's Longspur *Calcarius picius*	SR&M	Meadows	Rarely
Lapland Longspur *Calcarius lapponicus lapponicus*	WR&M	Meadows	Occasional
Snow Bunting *Plectrophenax nivalis nivalis*	WR	Fields & marshes	Uncommon

Species	Habitat Preference
PETROMYZONTIDAE - Lamprey family	
Northern brook lamprey - Ichthyomyzon fossor	Small rivers & creeks
Silver lamprey - Ichthyomyzon unicuapis	Large rivers
Ohio lamprey - Ichthyomyzon bdellium	Large & medium sized streams
Chestnut lampre - Ichthyomyzon castaneus	Lakes & rivers
American brook lamprey - Lampetra lamottei	Small streams
Least brook lamprey - Lampetra aepyptera	Small streams
POLYODONTIDAE - Paddlefish family	
Paddlefish - Polyodon spathula	Large silty rivers
ACIPENSERIDAE - Sturgeon family	
Lake sturgeon - Acipenser fulvescens	Quiet portions of large rivers and lakes
Shovelnose sturgeon - Scaphirhynchus platorynchus	Large silty rivers
LEPISOSTEIDAE - Gar family	
Longnose gar - Lepisosteus osseus	Standing waters & open waters at large rivers
Spotted gar - Lepisosteus oculatus	Clear weedy lakes
Shortnose gar - Lepisosteus platostomus	Main channels at large silty rivers
Alligator gar - Lepisosteus spatula	
AMIIDAE - Bowfin family	
*Bowfin - Amia calva	Various highly tolerant
ANGUILLIDAE - Eel family (Freshwater)	
American eel - Anguilla rostrata	Deep pools with mud bottom
CLUPEIDAE - Herring family	
Gizzard shad - Dorosoma eepedianum	Back waters of large rivers and their tributaries
CLUPEIDAE - Herring family (Cont'd)	
Threadfin shad - Dorosoma petenense	
Alabama shad - Alosa alabamae	
Skipjack herring - Alosa chrysocholoris	
SALMONIDAE - Salmon family	
Brown trout - Salmo trutta	Cool spring fed rivers & streams
Rainbow trout - Salmo gairdneri	Coll spring fed rivers & streams
HIODONTIDAE - Mooneye family	
Goldeye - Hiodon alosoides	Large silty rivers
UMBRIDAE - Mudminnow family	
Central mudminnow - Umbra limi	Soft-bottomed creeks, ditches & lakes
ESCOCIDAE - Pike family	
Grass pickerel - Esox americanus vermiculatus	Weedy lakes, streams & ditches
Northern pike - Esox lucius	Weedy lakes & streams
Muskellunge - Esox masquinongy	Clear streams with deep pools
CYPRINIDAE - Minnow family (and carps)	
*Carp - Cyprinus carpio	Sluggish streams, lakes with rich organic bottom
Goldfish - Carassius auratus	Sluggish streams, lakes with rich organic bottom
Blacknose dace - Rhinichthys atratulus	Swifter parts of cool creeks having hard bottoms

* Has been collected in the watershed by Soil Conservation Service and U.S. Fish and Wildlife Service biologists.

Species	Habitat Preference
CYPRINIDAE - Minnow family (and carps) (Cont'd)	
*Creek chub - Semotilus atromaculatus	Creeks, often gravel bottom
Hornyhead chub - Nocomis biguttata	Creeks, usually gravel bottom
River chub - Nocomis micropogon	Larger streams with riffles and flowing pools
Silver chub - Hybopsis storeriana	Large silty rivers
Bigeye chub - Hybopsis amblops	Large streams with hard bottoms
Speckled chub - Hybopsis aestivalis	Large silty rivers
Streamline chub - Hybopsis dissimilis	Clear moderate-sized streams with hard bottoms
Gravel chub - Hybopsis x-punotata	
Bullhead minnow - Pimephales vigilax	Sluggish pools of larger streams
Fathead minnow - Pimephales promelas	Quiet water of small streams and ponds
Bluntnose minnow - Pimephales notatus	Varies high tolerant
Pugnose minnow - Notropis emiliae	Slow streams with muddy bottoms
*Silverjaw minnow - Ericymba buccata	Sand bottom streams & lakes
Redside dace - Clinostomus elongatus	
Southern redbelly dace - Phoxinus erythrogaster	
Golden shiner - Notemigonus crysoleucas	Slow moving, pools or lakes with mucky bottom
Redfin shiner - Notropis umbratilis	Creeks and streams
Rosefin shiner - Notropis ardens	Clear streams with hard bottoms
Steelcolor shiner - Notropis whipplei	Large & medium streams
Silverband shiner - Notropis shumardi	
Striped shiner - Notropis chrysocephalus	
*Common shiner - Notropis Cornutus	Streams

Species	Habitat Preference
CYPRINIDAE - Minnow family (and carps)	
Ribbon shiner - Notropis fumeus	
Popeye shiner - Notropis ariommus	Clear rapid streams
*Emerald shiner - Notropis atherinoides	
Silver shiner - Notropis photogenis	Fast water in large streams
Rosyface shiner - Notropis rubellus	Riffles in hard bottomed streams
Bigeye shiner - Notropis boops	Clear gravel bottomed streams with moderate current
Pugnose shiner - Notropis anogenus	Slow muddy bottomed streams
Blacknose shiner - Notropis heterolepis	Lakes & slow streams, weedy areas
Blackchin shiner - Notropis heterodon	Quiet, weedy areas in lakes and streams
Pallid shiner - Notropis amnis	Streams with sand bars
Spotfin shiner - Notropis spilopterus	Clear heavily vegetated ditches
Bigmouth shiner - Notropis dorsalis	Small rivers
River shiner - Notropis blennius	Sand & gravel bottomed large streams
Sand shiner - Notropis stramineus	Sand bottom streams
Ghost shiner - Notropis buchanani	
Mimic shiner - Notropis volucellus	Lakes, slow moving parts of rivers & quiet pools of creek
Silvery minnow - Hybognathus nuchalis	Large silty rivers
Cypress minnow - Hybognathus hayi	
*Suckermouth minnow - Phenacabius mirabilis	Fast water streams
*Stoneroller - Campostoma anomalum	Streams with hard bottoms

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Species	Habitat Preference
CASTOSTOMIDAE - Sucker family	
Blue Sucksr - *Cycleptus elongatus*	Large turbid streams of S. Indiana
Quillback - *Carpiodes cyprinus*	Rivers and streams
River carpsucker - *Carpiodes carpio*	Rivers and streams
Highfin carpsucker - *Carpiodss velifer*	Large silty rivers
Bigmouth buffalo - *Ictiobus cyprinellus*	Slow portions of large streams
Black buffalo - *Ictiobus niger*	Large strsams & lakes
Smallmouth buffalo - *Ictiobus bubalus*	Rivers, streams, bayous & swamps
Spotted sucker - *Minytrema melanons*	Streams and lakes with soft bottoms
Creek chubsucker - *Erimyzon oblongus*	Various-highly tolerant
Black redhorse - *Moxostoma duguesnei*	Small & medium streams with hard bottoms
Silver redhorse - *Moxostoma anisurum*	Large & medium streams with hard bottoms
Golden redhorse - *Moxostoma erythrurum*	Small & medium streams with hard bottoms
Shorthead redhorse - *Moxostoma macrolepidotum*	Rivers & medium streams with hard bottoms
River redhorse - *Moxostoma carinatum*	
Greater redhorse - *Moxostoma valenciennesi*	
Harelip sucker - *Lagochila lacsra*	
Northern hog sucker - *Hypentelium nigricans*	Small streams with hard bottoms
*White sucker - *Catostomus commsrsoni*	Varied, generally clear, flowing water
ICTALURIDAE - Freshwater catfish family	
Flathead - *Pylodiotis olivaris*	Large rivers & a few of their tributaries

Species	Habitat Preference
ICTALURIDAE - Freshwater catfish family (Cont'd)	
Yellow bullhead - *Iotalurus natalis*	Slow streams & lakes with soft bottoms
*Brown bullhead - *Ictalurus nebulosus*	Slow streams & lakes with soft bottoms
Blaok bullhead - *Ictalurus mslas*	Slow streams & lakes with soft bottoms
Blue catfish - *Ictalurus furcatus*	Large rivsrs
Channel catfish - *Ictalurus punotatus*	Rivers and lakes
White catfish - *Ictalurus catus*	Lakes with soft bottoms
Freokled madtom - *Noturus nocturnus*	Streams with firm bottoms
Stonecat - *Noturus flavus*	Medium & large strsams with rock or gravel bottom
Tadpole madtom - *Noturus gyrinus*	Slow, weedy, soft bottomed streams
Mountain madtom - *Noturus eleutherus*	Fast waters of medium to large sizsd strsams with hard bottoms of rock or gravel
Brindled madtom - *Noturus miururs*	Riffles of hard bottomed streams
AMBLYOPSIDAE - Cavefish family	
Northern cavefish - *Amblyopis spelaea*	Limestone caves
Southern cavefish - *Typhlichthys subterraneus*	Limestone caves
Spring cavefish - *Chologaster agassizi*	
APHREDODERIDAE - Pirate perch family	
Pirate perch - *Aphredodsrus sayanus*	Weedy areas in clear streams
PERCOPSIDAE - Trout-perch family	
Trout-perch - *Percopsis omiscomaycus*	Larger streams

* Has been collscted in the watershed by Soil Conservation Service and U.S. Fish and Wildlife Service biologists.

Species	Habitat Preference
CYPRINODONTIDAE - Killifish family	
Northern studfish - Fundulus catsnatus	Gravel riffles in clsar streams
*Blackstrips topminnow - Fundulus notatus	Wsedy areas in streams & lakes
*Starhead topminnow - Fundulus notti	Weedy arsas in streams & lakes
POECILIIDAE - Livsbearer family	
Mosquitofish - Gambusia affinis	Quiet vsgetatsd waters at swamps & bayous
ATHERINIDAE - Silvsrside family	
Brook silversids - Labidesthes sicculus	Streams & lakes
GASTEROSTEIDAE - Stickleback family	
Brook stickleback - Culasa inconstans	Small streams
COTTIDAE - Sculpin family	
Banded sculpin - Cottus carolinae	Riffles in clsar unpollutsd streams and creeks
Mottled sculpin - Cottus bairdi	Riffls in clear unpolluted streams and crseks
PERCICHTHYIDAE - Temperate basses	
White bass - Morone chrysops	(Various) Large silty rivers to clear glacial lakss
Yellow bass - Morone mississippiensis	Larger rivers
CENTRARCHIDAE - Sunfish family	
Largemouth bass - Micropterus salmoides	Lakes, streams & rivers
Spotted bass - Micropterus punctulatus	Streams of moderate, current and desp pools
Smallmouth bass - Micropterus dolomieui	Gravel-bottomed streams & lake arsas
Warmouth - Chaenobryttus gulosus	Slow strsams & lakes with soft bottoms
*Green sunfish - Lepomis cyansllus	Lakss & crseks, weedy areas
Spotted sunfish - Lepomis punctatus	

Spscies	Habitat Preference
CENTRARCHIDAE - Sunfish family (Cont'd)	
Orangespotted sunfish - Lepomis humilis	(Various) wesdy ditchss to large rivers
*Longear sunfish - Lepomis msgalotis	Lakss and streams
*Bluegill - Lepomis macrochirus	Lake & pools in streams, wssdy arsas.
Pumpkinssed - Lepomis gibbosus	Lakss & streams
Redear sunfish - Lepomis microlophus	Lakes & streams
Rock bass - Ambloplites rupsstris	Hard bottomsd strsams
Flisr - Centrarchus macroptsrus	
White crappis - Pomoxis annualaris	Lakss & streams, mud bottoms, clsar or turbid
Black crappie - Pomoxis nigromaculatus	Lakes & strsams, mud bottoms, clsar, weedy area
PERCIDAE - Perch family	
Yellow perch - Psrca flavescens	Lakes & soms streams
Sauger - Stizostedion canadense	Large silty rivsrs
Walleye - Stizostedion vitreum	Lakes, rivsrs & streams
Crystal darter - Ammocrypta asprella	
Eastsrn sand darter - Ammotrypta pellucida	Large and msdium sized streams with sand bottoms
Wsstsrn sand dartsr - Ammocrypta clara	Large rivers
Logperch - Percina caprodss	Riffles in rivsrs & streams
Blacksids darter - Percina maculata	Pools in small & medium streams
Gilt darter - Percina svidss	Swift streams
Slenderhead darter - Psrcina phoxocephala	Riffles in creeks & ditches
Dusky dartsr - Percina sciera	Fast shallow streams with gravsl bottoms
Channel darter - Percina copslandi	Fast streams with sand or gravel bottoms

* Has besn collected in ths watershed by Soil Conservation Ssrvice and U.S. Fish and Wildlife Service biologists.

Species	Habitat Preference
PERCIDAE - Perch family (Cont'd)	
River darter - Percina shumardi	Large silty rivers
Stargazing darter - Percina uranidea	
Greenside darter - Etheostoma blennioides	Riffles in small & medium streams
Bluntnose darter - Etheostoma chlorosomum	
*Johnny darter - Etheostoma nigrum	Lakes & quiet waters of streams with sand or gravel bottom
Least darter - Etheostoma microperca	
Slough darter - Etheostoma gracile	Sluggish streams & swamps
Banded darter - Etheostoma zonale	Variable from fast streams to slow streams
Harlequin darter - Etheostoma histrio	
Variegate darter - Etheostoma variatum	Medium sized stream with swift riffles of large rocks
Bluebreast darter - Etheostoma camurum	Swift rocky riffles
Mud darter - Etheostoma aspringene	
Tippecanoe darter - Etheostoma tippecanoe	
*Rainbow darter - Etheostoma caeruleum	Fast stony riffles of creeks & medium sized streams
Orangethroat darter - Etheostoma spectabile	Creeks with riffles
Spottail darter - Etheostoma squamiceps	
Fantail darter - Etheostoma flabellare	Gravelly and stony riffles at small creeks
SCIAENIDAE - Drum family	
Freshwater drum - Aplodinotus grunniens	Back waters & sluggish streams.

References:

Indiana Fish Species IDNR

Investigations of Indiana Lakes & Streams, Volume III
1. Shelby D. Gerking: Distribution of the Fishes of Indiana
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Division of Fish and Game
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Indianapolis 1945

Northern Fishes
with special reference to the
Upper Mississippi Valley
by Samuel Eddy, University of Minnesota
and
Thaddeus Surber, Minnesota Department of Conservation
The University of Minnesota Press 1947

Fishes of Indiana
Bulletin No. 7
Indiana Department of Conservation, Division of Fish and Game
June 1964

A Field Manual of Kentucky Fishes

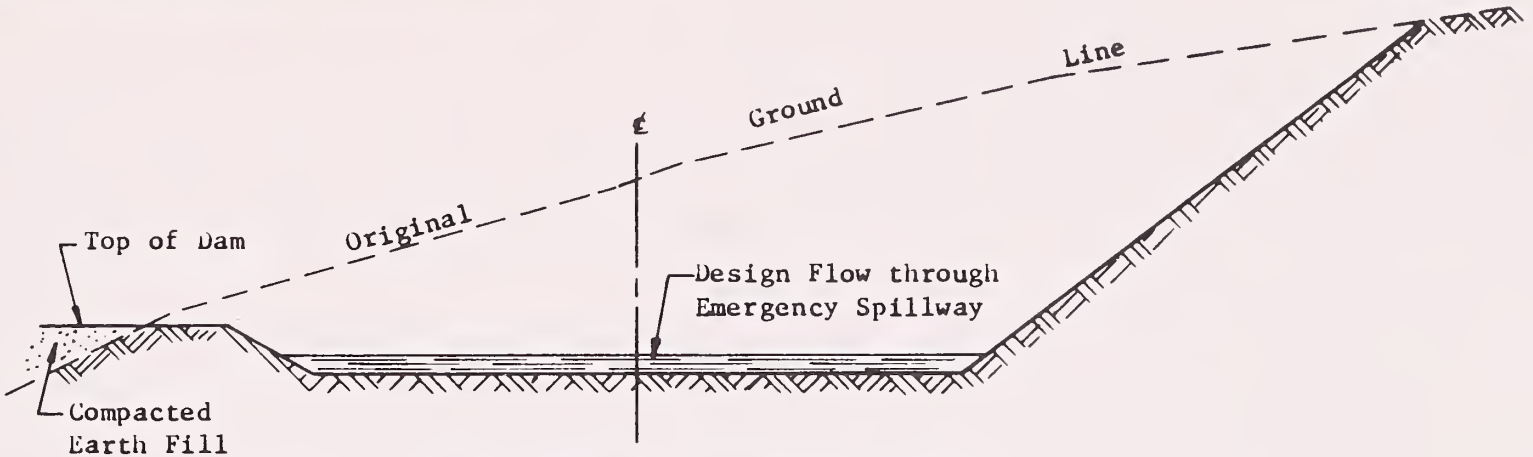
by William M. Clay
Kentucky Department of Fish and Wildlife Resources
1962

* Has been collected in the watershed by Soil Conservation Service and U.S. Fish and Wildife Service biologists.

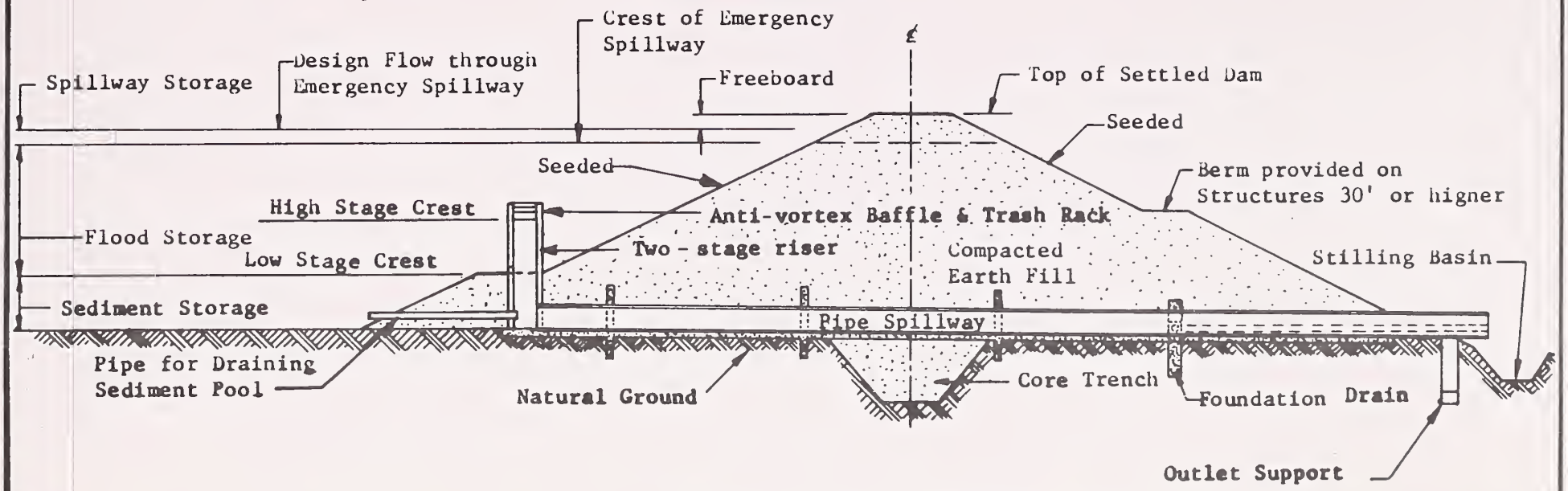
APPENDIX D

U.S. Department of Agriculture

Soil Conservation Service



CROSS SECTION OF EMERGENCY SPILLWAY
CONTROL SECTION

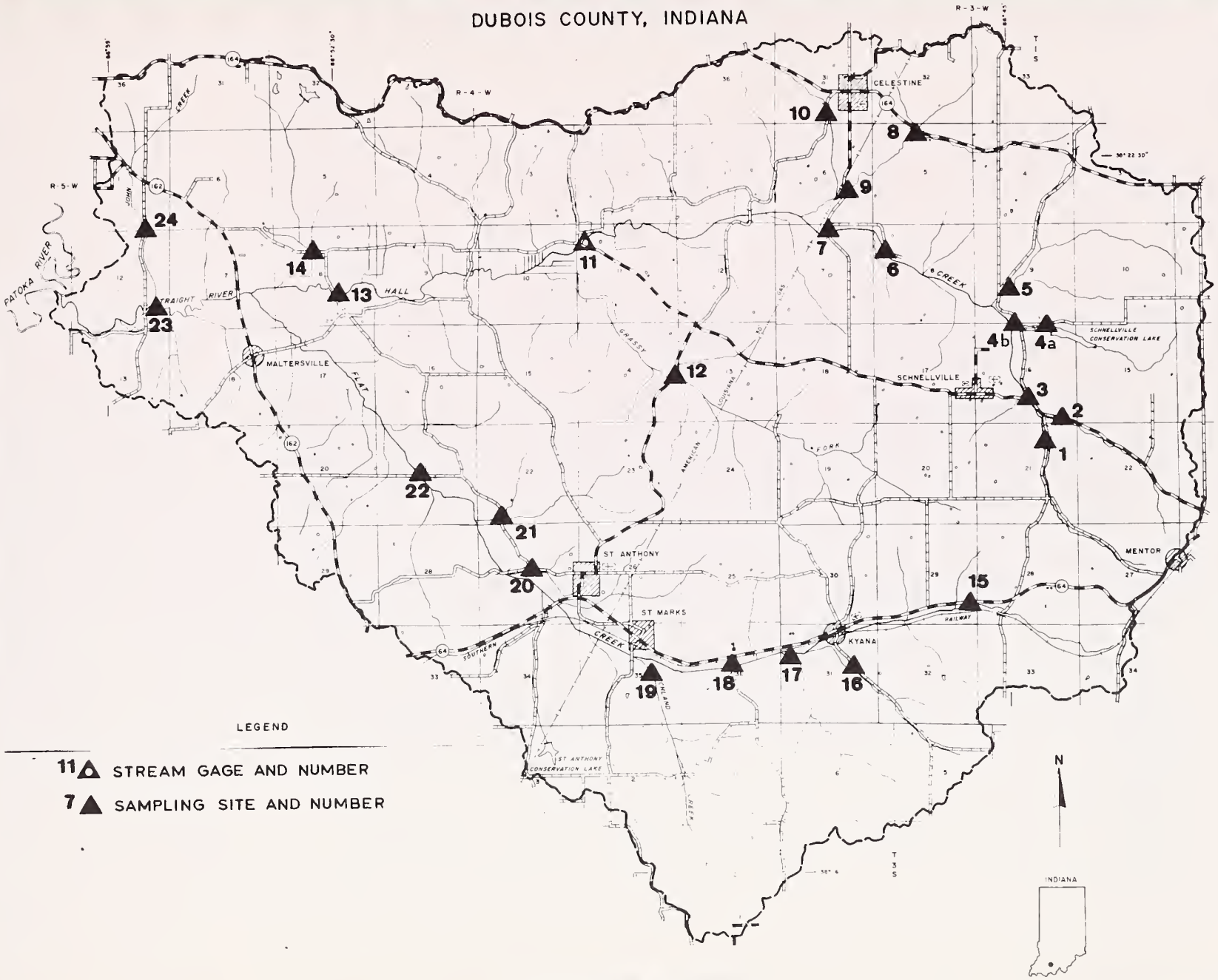


CROSS SECTION ALONG PRINCIPAL SPILLWAY
OF TYPICAL SINGLE PURPOSE STRUCTURE

Figure 1

APPENDIX E

WATER QUALITY SAMPLING SITES
HALL-FLAT CREEK WATERSHED
DUBOIS COUNTY, INDIANA



SOURCE
S C S DRAWING NO 8,5-24,014

Rev 10-17-67
7-26-67
5,5-25,133

Hall-Flat Creek Field Data

Site	Time* (EST)	Est.** Disch. (ft^3/s)	Temp. (°C)	Spec. Cond. (umhos)	Dissolved Oxygen (mg/l)	Dissolved Oxygen (% sat.)
1	1755	.8	13.8	141	11.2	108
2	1740	.8	13.0	144	11.2	106
4a	1730	.5	12.0	171	10.2	94
4b	1720	.5	11.3	165	12.7	123
5	1705	.8	11.0	185	13.2	127
8	1430	.3	13.3	240	11.9	113
10	1420	.3	13.8	233	14.0	135
13	0830	---	9.7	197	10.3	90
14	0815	.6	6.4	200	12.5	101
15	1020	.9	7.8	188	12.3	103
16	1035	.6	8.2	184	12.8	108
17	1055	1.8	8.4	145	12.8	108
20	1315	.1	11.0	229	10.8	97
21	1330	.7	9.6	188	12.4	109
24	1440	.4	10.4	220	15.6	139

* Sites 1-10 measured April 15; others measured April 16.
** Surface velocity estimation technique.

January 1976

Hall-Flat Creek Watershed Chemical Data

Site	3	6	9	11	12	18	19	22	23
Time (EST)*	1815	1600	1515	0850	0930	1115	1230	1345	1515
Discharge (ft^3/s)	2.8	4.0	1.0	7.4	1.5	3.7	1.3	7.4	21
Water temp. (°C)	13.1	13.7	15.1	9.2	7.0	8.6	9.9	9.8	10.8
Specific Cond. (umhos)	130	182	200	190	180	175	125	180	180
Dissolved Oxygen (% sat)	100	121	127	95	102	109	112	100	106
Dissolved Oxygen	11.4	12.6	13.0	10.9	12.4	12.7	12.6	10.2	11.8
Calcium	17	20	18	20	17	16	9.5	20	18
Magnesium	4.0	7.3	8.8	7.7	8.0	5.6	4.1	6.3	6.9
Potassium	2.1	2.5	2.1	2.3	1.4	1.4	1.1	1.8	1.8
Sodium	5.1	5.9	7.7	7.0	5.6	5.0	3.9	5.5	6.5
Bicarbonate	36	46	29	43	25	28	14	28	37
Carbonate	0	0	0	0	0	0	0	0	0
Chloride	6.2	7.5	8.3	7.9	5.3	5.9	3.5	5.8	7.6
Fluoride	0	0	0	0	0	0	0	0	0
Sulfate	30	41	59	45	53	40	36	42	44
Silica, dissolved	6.9	5.4	5.6	4.9	6.7	6.7	7.9	6.7	5.7
Dissolved soilds	91	119	130	123	114	98	76	109	114
Total alkalinity (as $CaCO_3$)	30	38	24	35	21	23	11	23	30
Total hardness (as $CaCO_3$)	59	80	81	82	75	62	41	76	73
Noncarb. hardness (as $CaCO_3$)	29	42	57	46	55	40	29	53	43
Ammonia, dissolved (as N)	0	.07	0	.07	.04	.02	0	.5	.01
Organic nitrogen, dissolved (as N)	.06	.16	.08	.11	.08	.06	.01	0	.14
Kjeldahl nitrogen, dissolved (as N)	.06	.23	.08	.18	.12	.08	.01	.5	.15
Nitrite, dissolved (as N)	.01	.02	.01	.03	.01	.01	.01	.01	.02
Nitrate, dissolved (as N)	.50	1.3	1.3	1.3	.86	.78	.57	1.1	1.2
Orthophosphate, dissolved, (as P)	.02	.01	0	0	0	0	0	0	0
Phosphate, dissolved (as P)	.03	.02	.01	.01	.01	0	0	.02	.01
Organic carbon, dissolved		3.9			21	8.6			
Iron dissolved	.04	.09	.04	.02	.06	.03	.06	.09	.10
Manganese, dissolved	.03	.26	.08	.82	.21	.14	.13	.24	.26
Total coliform**	110	250	70[e]			35[e]	20[e]	360[e]	
Fecal streptococci**	140	100	5[e]			75[e]	50[e]	8,800[e]	

*Sites 3, 6, and 9 collected April 15, others collected April 16.
**Colonies per 100 milliliters
[e]Estimated value based on nonideal colony count

January 1976

APPENDIX F

FREQUENCY - DISCHARGE - STAGE RELATIONSHIP FOR SELECTED LOCATIONS
Without Project and With Project Installed
Hall-Flat Creek Watershed, Indiana

Rec. No.	I.D. No.	Damage Begins Elev.	1 Year Flood				10 Year Flood				100 Year Flood			
			Without Proj.		Proj. Inst.		Without Proj.		Proj. Inst.		Without Proj.		Proj. Inst.	
			Disch.	Elev.	Disch.	Elev.	Disch.	Elev.	Disch.	Elev.	Disch.	Elev.	Disch.	Elev.
			c.f.s.	ft.	c.f.s.	ft.	c.f.s.	ft.	c.f.s.	ft.	c.f.s.	ft.	c.f.s.	ft.
1	28	*	4162	450.61	2833	449.42	9676	453.42	6264	451.94	16265	455.22	9778	453.47
	27	449.0	4185	452.70	2828	451.83	9808	455.19	6290	453.78	16532	457.12	9863	455.21
2	15	452.6	4151	456.23	2737	454.81	9672	458.85	6096	458.36	16292	461.50	9559	458.84
3	14	457.8	2388	459.11	1424	458.53	6036	460.58	3030	459.46	10164	462.12	4828	460.29
	11	463.0	2332	466.33	1358	464.91	5939	469.50	2795	467.02	10031	470.78	4440	468.44
	7	467.5	2339	469.17	1329	468.33	5937	471.12	2712	469.45	9985	472.49	4335	470.36
4	6	472.5	1904	474.05	898	472.97	4832	476.17	2176	474.30	8071	477.51	3627	475.46
	5	478.9	1908	480.23	856	479:05	4789	481.68	2172	480.41	7999	482.83	3649	481.16
5	4	483.0	1485	485.44	764	484.32	3944	487.19	1940	485.85	6538	488.50	3081	486.68
	3	491.5	1605	492.39	776	491.03	4091	493.90	1989	492.71	6758	494.93	3138	493.32
6	2	497.5	967	498.52	657	497.92	2678	500.33	1792	499.52	4397	501.30	3023	500.52
	55	507.8	930	508.30	581	507.60	2401	509.62	1434	508.96	3725	510.39	2178	509.42
	1	529.0	840	527.87	402	526.24	2243	530.68	1027	528.36	3448	531.73	1665	529.84
7	10	468.2	821	469.42	429	468.53	2026	471.11	1029	469.81	3240	472.29	1591	470.61
	9	476.0	841	477.57	486	476.96	2301	478.91	1304	478.14	3768	479.97	2116	478.79
	8	468.2	757	487.25	430	486.29	1909	488.79	1145	487.85	3006	489.73	1787	488.62
8	24	457.4	1831	459.10	1263	458.72	4845	460.62	2995	459.81	7998	461.81	4872	460.63
	23	462.9	1901	464.25	1288	463.88	5003	465.35	2978	464.70	8246	466.32	4851	465.30
	22	469.8	1852	471.73	1236	471.17	4720	473.35	2745	472.37	7697	474.62	4413	473.21
	21	475.5	1834	477.25	1175	476.74	4573	478.73	2580	477.80	7415	479.76	4125	478.56
9	20	482.3	1759	483.47	1037	482.70	4314	485.20	2307	483.80	6910	486.83	3445	484.60
	19	487.6	1403	489.02	930	488.35	3438	490.62	2027	489.65	5562	491.72	3065	490.38
	18	498.2	1133	499.09	886	498.70	2528	500.53	1892	499.99	3860	501.14	2841	500.70

* Area for cross section included in cross section 27 for economic evaluation.
Note: Land treatment will further reduce the discharge approximately 3.5 percent.

ACRES FLOODED AND DOLLAR DAMAGES BY REACH

Reach Number	Percent Damage Reduction	ACRES FLOODED & DOLLARS DAMAGE 1/ BY REACH											
		1 Year Flood				10 Year Flood				100 Year Flood			
		Without Proj.		With Strs.		Without Proj.		With Strs.		Without Proj.		With Strs.	
		Ac.	$	Ac.	$	Ac.	$	Ac.	$	Ac.	$	Ac.	$
1	24	419	13,129	391	9,976	457	16,378	442	15,007	472	17,244	458	16,392
2	28	635	18,923	587	13,850	670	23,773	664	22,904	687	24,663	669	23,687
3	36	659	24,165	558	15,973	717	31,472	685	26,956	744	36,785	709	29,663
4	55	397	13,663	255	6,138	431	19,186	379	13,549	443	21,865	412	15,279
5	58	213	6,023	58	1,752	237	9,595	219	7,470	244	11,633	227	8,998
6	54	39	689	9	142	66	1,598	49	1,123	74	1,914	64	1,502
7	51	210	4,457	124	2,018	265	6,610	235	5,445	288	8,696	257	6,348
8	27	768	25,395	660	18,908	919	36,522	845	29,518	948	43,918	900	35,754
9	49	327	9,550	205	4,943	438	15,985	364	12,291	481	20,917	410	14,849
TOTAL	42	3,667	115,994	2,847	73,700	4,200	161,119	3,882	134,263	4,381	187,635	4,106	152,472

1/ Dollars Damage to crops and pasture only. Table only shows benefits attributable to structures. Additional damage reduction of 6 percent provided by land treatment.

APPENDIX G

DEPARTMENT OF THE ARMY
LOUISVILLE DISTRICT CORPS OF ENGINEERS
P O BOX 59
LOUISVILLE, KENTUCKY 40201

ORLPD-R

2 April 1976

Mr. Cletus J. Gillman
State Conservationist
Soil Conservation Service
5610 Crawfordsville Road
Suite 2200
Indianapolis, Indiana 46224

Dear Mr. Gillman:

This office has completed the requested review of the Draft Watershed Plan and Environmental Impact Statement for the Hall-Flat Creek Watershed, Dubois County, Indiana.

Maltersville Reservoir, as noted, is an active Corps of Engineers' project for possible long range development. However, rapidly changing conditions, a lack of local support, and a low benefit to cost ratio (just above unity when studied) would seem to preclude any action on the implementation of this project for some time to come. At present, no funds are available for further study.

The following additional comments are given for your consideration.

a. A regional map would be helpful in illustrating the project area's relationship to population centers and major waterways.

b. Information on aquatic populations in the project area is rather sparse. Considering the nature of this project, it might be advisable to conduct a field survey of aquatic species and include in the appendices a list of fish possibly affected.

c. The section on water quality indicated a potential exists for significant degradation due to biological activity. Further information on the possibility of eutrophication in the impoundments could be discussed in the final.

d. A glossary of technical terms would be helpful for the lay reader.

e. In Appendix C, it was noted that the "occurrence in area" was omitted for the Indiana bat.

The larger streams in the Hall-Flat Creek watershed, those with normal flows in excess of 5 cfs, will come under Corps' jurisdiction on 1 July 1977 in relation to Section 404 of Public Law 92-500. Any discharge of dredged or fill material below ordinary high water elevation on one of these streams after 1 July 1977 will require a Department of the Army permit. The statement implies that most of the streams to be impounded are ephemeral. This jurisdiction does not include ephemeral streams but will normally extend to that point of the stream where normal flow is 5 cfs. In the case of water quality concerns, jurisdiction can be exercised over a stream where normal flow is less than 5 cfs.

The opportunity to review this draft statement is appreciated. If you require further assistance, please contact this office.

Sincerely yours,

NEAL E. JENKINS
Chief, Planning Division

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
REGION V
300 SOUTH WACKER DRIVE
CHICAGO, ILLINOIS 60606

OFFICE OF
THE REGIONAL DIRECTOR

March 18, 1976

Mr. Cletus J. Gillman
State Conservationist
Department of Agriculture
5610 Crawfordsville Road, Suite 2200
Indianapolis, Indiana 46224

Dear Mr. Gillman:

RE: Draft Environmental Impact Statement
Hall-Flat Creek Watershed
Dubois County, Indiana

We have reviewed the Draft Environmental Impact Statement for the above project. To our knowledge, and based upon the information provided, this project will not impact to any significant degree on the health, education or welfare of the population.

Sincerely,

Robert A. Ford

Robert A. Ford
Regional Environmental Officer

cc: Charles Custard, OEA
Warren Muir, CEQ

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

PEP ER-76/176

APR 13 1976

Dear Mr. Gillman:

This is in response to your February 13, 1976, request for our review of the work plan and draft environmental statement for Hall-Flat Creek Watershed, Dubois County, Indiana. We have the following comments on both documents.

Work Plan

No provision is set forth in the watershed plan for minimum release of water from the 22 impoundments, particularly during dry periods of the year. In a 67.35 square mile watershed, runoff from 25.12 square miles (37 percent), will be intercepted by the impoundments. With approximately 15 percent of the runoff in the watershed subject to impoundment in the reservoirs, we are concerned with the effect of altered water supply (both in volume and periodicity) on existing fishery resources from the downstream portions of Hall-Flat Creek and Straight River.

The included list of fishes indicates that the watershed supports a diverse fishery resource. If a substantial volume of flow is withheld during dry periods, the result could be devastating to existing populations of fish and aquatic invertebrates in dewatered reaches of the streams.

The following table presents the average flow in cubic feet per second (cfs) for water years 1971 through 1974 for Hall Creek at the U. S. Geological Survey gauging station located 3.3 miles north of St. Anthony, Indiana.

Average Stream Flow Data, Hall Creek

Month	Average Flow (cfs)
October	4.32
November	14.76
December	31.80
January	37.25
February	41.95
March	57.98
April	58.10
May	20.13
June	11.76
July	4.59
August	5.22
September	5.33

Since Flat Creek is similar in size to Hall Creek, we have assumed similar runoff data for Flat Creek. To provide minimum protection for aquatic resources in downstream reaches, and to augment natural unaltered flow, we recommend that daily minimum water releases be made from each dam and reservoir to total 1.0 cfs from July 1 through October 31 and 2.0 cfs from November 1 through June 30. The amount of release from each reservoir should be proportionate to the drainage area it intercepts.

The plan indicates (pages I-13 and 14) that as mitigation for wildlife habitat loss to project dams and reservoirs, the easement area from the flood pool line to the sediment pool line (323 acres) will be set aside as a wildlife area with appropriate permanent markers. This land will be allowed to revegetate by natural succession except for five conditions listed in the plan. These conditions may be applicable to all the impoundments, thereby eliminating or greatly reducing this mitigation feature.

We recommend that this section be supplemented with an analysis indicating the value of wildlife habitat to be destroyed, and which exceptions to the natural revegetation plan will be applicable on an acre by acre basis at each of the 22 reservoir sites. This analysis also is necessary to provide meaning to the environmental statement in respect to what losses are anticipated and what degree of mitigation is being planned.

If properly managed, it is our opinion that the 22 impoundments could be beneficial to fish and wildlife. Certainly, management of the existing impoundments (Numbers 50, 52, and 53) has benefited the fishery resources of the area. However, livestock should be excluded from having direct access to the proposed impoundment areas, as they apparently have been excluded from the existing impoundments. In addition to denuding the shore areas and increasing turbidity of the water, livestock can cause excessive algal blooms and accelerated plant growth. Increased eutrophication, caused by livestock waste, will lower the water quality, thus preventing successful production of quality sport fish.

The environmental statement indicates that limited access for fishing may be provided to the general public for some of the pools if sufficient easements can be obtained without significant increase in cost. We fully support public access to all federally assisted reservoirs and suggest that detailed plans for achieving such access be included in the work plan. In addition, we recommend that appropriate impoundments be managed for waterfowl. The Department's Fish and Wildlife Service will offer technical assistance for waterfowl management upon request.

Environmental Statement

The draft statement adequately describes impacts on outdoor recreation and related environmental values.

Planned Project

We believe that the following items regarding groundwater need additional consideration:

1. The statement should consider how often and how long the structures will impound less than crest-level amounts and evaluate the effects of such temporary impoundments (including that of the volumes designated for ultimate sediment storage) on groundwater levels and adjacent land use.

2. Page II-7 -- The statement should consider effects on groundwater of increased infiltration resulting from contour farming.

3. Page II-7 -- Presumably all subsurface drainage of groundwater will be beneficial, but this impact should be evaluated.

4. Page II-8 -- Spring development by excavation should be more fully explained. Presumably no explosives would be involved which might destroy some types of springs; but if the purpose is solely to create catchment basins, this should be mentioned.

5. Page II-8 -- Spring "capping" also needs more explanation; for an interruption of spring flow in one place (if this is the meaning) may result in troublesome breakouts elsewhere.

Environmental Setting

Effects of erosion of coal mine tailings (page II-21, paragraph 4) by storm-water runoff on the chemical and physical quality of surface water should be assessed.

The following fish and bivalve shells have been collected by Soil Conservation Service and U.S. Fish and Wildlife Service biologists in the watershed area; Straight River, Flat Creek, Hall Creek, and Grassy Fork on July 1, August 18 and 19, and September 4 and 5, 1975. We recommend this list be included in the final statement.

Fishes

Bowfin
Gizzard shad
Redfin pickerel
Carp
Stoneroller
Suckermouth minnow
Creek chub
Silverjaw minnow
Common shiner
Emerald shiner
White sucker
Brown bullhead
Madtom
Blackstripe topminnow
Starhead topminnow
Green sunfish
Longear sunfish
Bluegill
Johnny Darter
Rainbow darter

Bivalve Shells

Scientific Name	Common Name
Spaerium (Sp.)	Fingernail clam
Anodonta grandis grandis	Floater
Lasmigona complaneta	White heel-splitter
Uniomerus tetralasmus	Pond horn
Lampsilis teres	Slough sand shell
Lampsilis radiata luteola	Fat mucket
Ligumia subrostrata	Pond mussel
Leptodea fragilis	Fragile paper shell

We are pleased to note that the Soil Conservation Service has instituted appropriate procedures to locate and identify cultural resources within the project area. While it is indicated on page 31 that an archeological and historical reconnaissance of the 22 structure sites has been contracted for, the scope of the reconnaissance is unclear. The statement should provide assurance that the surveys undertaken have not been limited to structure sites alone but include all areas to be inundated, all borrow areas, any utility relocations or installations, all equipment storage sites, any grade stabilization structure location, and any areas in which subsurface drains will be installed.

The statement should confirm that the State Historic Preservation Officer, Mr. Joseph D. Cloud, has been consulted in making the determination that no sites that may be eligible for addition to the National Register of Historic Places would be affected by the proposed action.

The watershed is underlain by the Mansfield Formation of Early Pennsylvanian age containing sandstone, limestone, clay, shale, and some coal. Coal is thin-bedded and of low quality in the watershed, but it is being strip mined seven miles to the west. The nearest site of mineral production is a clay mine five miles away. No other mineral resources are known. Although we were unable to perform a field survey, we believe that the proposed project should have no significant effect on mineral production or resources.

Environmental Impacts

Reference to converting 972 acres of forest land to cropland has been deleted in the subject statement. However, land use shifts will still result from the proposed action. Not only is the impact on fish and wildlife of converting 972 acres of forest land to cropland not addressed in the statement, but land use shifts resulting from the project have not been stated in the draft document. There are procedures available in which aerial photographs and field examinations are used to rate particular land areas to judge overall project impacts on wildlife. The value of land areas to be altered by the project are compared to those replacement areas which would be managed for wildlife with the project. The Fish and Wildlife Service is available to assist you in performing such an analysis.

The environmental statement should discuss the impact of the 22 reservoirs upon the flow regimes of the watershed and the aquatic resources supported therein. Fishes may have adapted to the spring high water conditions of the stream, taking advantage of adequate flows to migrate to headwater areas for spawning. This activity could be prevented by flow regulations, and, of course, migration past the impoundments will be stopped as there is no provision for upstream fish passage facilities.

We hope these comments will be of assistance to you.

Sincerely yours,

Deputy Assistant Secretary of the Interior

Mr. Cletus J. Gillman
State Conservationist
Soil Conservation Service
Department of Agriculture
5610 Crawfordsville Road, Suite 2200
Indianapolis, Indiana 46224

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
REGION V
230 SOUTH DEARBORN ST.
CHICAGO, ILLINOIS 60604

RE: 76-011-932
D-SCS-F36032-IN

Mr. Cletus J. Gillman
State Conservationist
U. S. Department of Agriculture
Soil Conservation Service
5610 Crawfordsville Road, Suite 2200
Indianapolis, Indiana 46224

Dear Mr. Gillman:

We have completed our review of the Draft Environmental Impact Statement (EIS) for Hall-Flat Creet Watershed, Dubois County, Indiana as requested in your letter of February 13, 1976. Based on the information presented in the Draft EIS, we have no major objections to the proposed project; but request additional information to assess the project's total environmental impacts. In addition, several points in the EIS are misleading and require clarification. We offer the following comments for your use in preparing the Final EIS.

Planned Project

This section was adequate with one exception. "Spring Development" needs to be explained in further detail. Attention should be given to the number of springs involved, and to the magnitude of excavation, structures, and facilities under consideration.

Environmental Setting

Information on water quality is very limited because it is chiefly the result of one day of sampling. Consequently, the conclusions (on pages 20 and 32) that water quality within the watershed is "good" should be presented with caution. A better assessment of water quality would be possible if additional data was available.

Information on point and non-point sources of pollution should be provided. The discussion on page 20 that an animal waste source is suspected of causing high fecal bacteria concentrations at one sampling point should have been discussed in further detail. Feedlots and other potential sources of pollution should be located and addressed.

It appears that none of the small communities within the watershed have sewage treatment plants of any kind. Septic systems must be in use, but the EIS does not address this. Due to the small size of these communities, and since they are not incorporated entities, it is very unlikely that Section 201 grants for

sewage treatment will be applied for or awarded. The watershed does not lie within a specific designated Section 208 study area. In addition, the Section 303e basin plan for this part of Indiana is not complete.

Long-term runoff information from the one stream gaging station indicated on the map in Appendix E should be provided if available. A major discussion within the EIS revolves around the number of acres flooded by annual, 10 year, and 100 year floods. The criteria that were used for determining these various flood stages (annual, 10 year and 100 year) should be discussed in detail.

The relationship between this proposed project and the proposed Maltersville Reservoir Project should be examined in more depth.

Water and Related Land Resource Problems

Specific water quality problems are not identified in this section. Instead, the discussion of water quality found in the Environmental Setting is merely shortened and repeated.

Information provided on page 40 is unclear and misleading. Crop and pasture damage without the project are estimated to be $117,556 for the annual flood. It should be explained if these damages are being incurred every year, of if they are estimates of damage which would result if flood plain acreage not being used for agriculture was converted to agricultural use.

It is implied on page 40 that the flood plain is "underused" because much of it has grown back into timber. This is very subjective. In our opinion, woodlands is a very appropriate use of flood plain land.

Environmental Impacts

In addition to discussing noise and air pollution, water quality impacts should be discussed, particularly the effects of construction activities. The EIS should include a discussion on construction practices which will minimize water quality impacts. Silt retention dams should be constructed to control siltation from the construction of the small impoundments.

Creation of 229 acres of open water beneficial to fish, terrestrial, and aquatic wildlife is listed as a favorable environmental impact on page 55. On page 56, the inundation of approximately 7.1 miles of ephemeral feeder streams within sediment pools is listed as an adverse environmental impact. If streams feeding these open water pools are ephemeral, it should be indicated how the pools will maintain water levels during dry periods. If they were to dry up quite regularly, their creation should only be

viewed as a degrading impact which would not be beneficial to fish and aquatic wildlife. This point should be addressed in the EIS. In addition, the EIS should provide more information on the proposed pools behind flood retarding structures. A description should be included of the pool dimensions and depths, nature and quality of pool releases, water quality within the pool, fish and aquatic wildlife which will inhabit the pools, and management practices.

As indicated in the above discussion and in accordance with EPA procedures, we have classified the proposed project as LO, lack of objection, and rated the Draft EIS as Category 2, additional information necessary. The date and classification of our comments will be published in the Federal Register. We appreciate the opportunity to review this Draft EIS. Please send us two copies of the Final EIS when it is filed with the Council on Environmental Quality. If you have any questions regarding our comments, please contact me at 312-353-5756.

Sincerely yours,

Robert I Kayfhofer

Gary A. Williams
Chief,
Environmental Review Section

STATE of INDIANA

INDIANAPOLIS, 46204

DEPARTMENT OF NATURAL RESOURCES
JOSEPH D. CLOUD
DIRECTOR

April 9, 1976

Mr. Cletus J. Gillman
State Conservationist
USDA
Soil Conservation Service
Atkinson Square West, Suite 2200
5610 Crawfordsville Road
Indianapolis, Indiana 46224

Dear Mr. Gillman:

This letter is in response to your letter of February 13, 1976, in regard to review of and comments of the Draft Plan and Draft Environmental Impact Statement on the Hall-Flat Creek Watershed.

The U. S. Soil Conservation Service should be complemented for combining the Watershed Work Plan and the Environmental Impact Statement into one document. This action eliminated much duplicate writing and gives the reviewer the complete picture.

However, the Report will still have to contain sufficient information so that a technical review can be made. We could not find what level of protection will be provided by the project.

The plan should contain a profile of the routed storms for the without project and with project conditions.

The table on page II-49 could be improved by showing the dollar damages in addition to the acres flooded.

Page II-12 states that a levee will be constructed below site No. 79, but there is no other information about the levee in the report.

On Page II-52, it states that the emergency spillway of 14 structures will be put into operation at a 10 year frequency and 8 structures at a 25 year frequency. These numbers are reversed according to Table 3. We thought the criteria for a class "a" structure was the containment of a 25 year frequency storm below or at the crest of the emergency spillway.

Page II-37 contains a reference to the Wabash River Basin Comprehensive Study. In that study, an estimate was made for reduction of flood flows out of Hall-Flat Creek Watershed, when evaluating the effects on Patoka River. How does the reduction of flood flows from the proposed Hall-Flat Creek Watershed Project compare with the estimates made during the Wabash River Basin Comprehensive Study?

The Project Map shows four structures in place. Are these structures part of the proposed watershed project? Were these existing structures given credit for any floodwater retarding effect in the hydraulic routings?

On page II-11 a statement is made that "All structures are designed with an expected life of 100 years." Is this statement correct?

The plan states, on page II-11, that a county road will be constructed across the top of the dam on Structure No. 32. In the case of this proposed structure, a bridge is required to cross the emergency spillway. It is the Natural Resources Commission's policy to only consider a road crossing an emergency spillway when the frequency of use is no more often than once in one hundred years.

The table on page II-49 gives data for evaluation reach XI. Reach XI is not shown on the Project Map.

There are no known historical or architectural sites affected by this project, but if any archaeological sites are discovered during construction, they should be reported to this office.

If we can be of further assistance, please advise.

Sincerely,

Joseph D. Cloud
Director
Department of Natural Resources

JDC/CCM:bjr

atoka Lake Regional Planning Commission

INDIANA PLANNING AND DEVELOPMENT REGION 15

Dubois County Courthouse
Jasper, Indiana 47546
Phone: (812) 482-5949

April 8, 1976

Mr. Cletus J. Gillman
State Conservationist
U.S. Department of Agriculture
Soil Conservation Service
5610 Crawfordsville Road
Suite 2200
Indianapolis, Indiana 46224

STATEMENT OF CLEARINGHOUSE REVIEW COMPLETION

PROJECT NO: 76-38 — Hall-Flat Creek Watershed
Draft - Plan and Environmental
Impact Statement

FEDERAL CATALOG NO: 10.904

The Regional Clearinghouse has circulated the above-referenced plan and environmental impact statement to selected regional agencies in accordance with its established review procedure. There were no adverse comments from the reviewing agencies.

With regard to this review, the Clearinghouse makes the finding that the proposed project is in accord with known regional, county, and local plans, goals and objectives at this time.

Sincerely,

Richard L. Henderson

Richard L. Henderson
Executive Director

OHIO RIVER BASIN COMMISSION

Suite 208-20
Cincinnati, Ohio 45202

36 East Fourth Street
513/684-3831 (FTS)

April 12, 1976

Mr. Cletus J. Gillman
State Conservationist
US Department of Agriculture
Soil Conservation Service
Atkinson Square-West, Suite 2200
Indianapolis, Indiana 46224

Dear Mr. Gillman:

Thank you for your letter of February 13, 1976 inviting comments of the Ohio River Basin Commission on the Draft Environmental Impact Statement (EIS) for the Hall-Flat Creek Watershed, Indiana.

In my opinion, the EIS has been properly coordinated with the Commission members.

The Ohio River Basin Commission staff has reviewed the draft EIS and finds no indication that the proposed action would not be compatible with the ORBC CCJP as it exists today.

The Commission looks forward to a continuing cooperative effort with your Department and appreciates your action in keeping us well informed.

Sincerely,

Fred E. Morr
Chairman

cc: Council on Environmental Quality
Joseph D. Cloud, Indiana